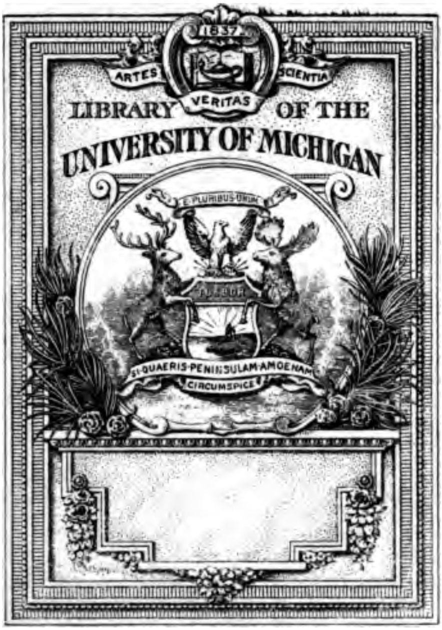
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AN OUTLINE OF PSYCHOLOGY

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OUTLINE OF PSYCHOLOGY

BY

EDWARD BRADFORD TITCHENER

NEW EDITION WITH ADDITIONS

New York
THE MACMILLAN COMPANY
LONDON: MACMILLAN & CO., LTD.
1902

Set up and electrotyped July, 1896. Reprinted March, November, 1897; September, 1898. Revised and enlarged edition printed October, 1899; October, 1900: October, 1901.

Russian translation, 1898; Italian translation, 1902.

Norwood Press
J. S. Cushing & Co. — Berwick & Smith
Norwood Mass. U.S.A.

To

SIR JOHN SCOTT BURDON SANDERSON, BART.

M.A., M.D., LL.D., F.R.SS.L. & E., ETC.

REGIUS PROFESSOR OF MEDICINE IN THE UNIVERSITY OF OXFORD

PREFACE TO THIRD EDITION

THE text of this third edition has been carefully revised, and the book as a whole is, I hope, considerably improved. Chapters I and XV have been rewritten, and the former enlarged by the insertion of two new Sections. Sections 12, 24, 32, 44, 69, 78, 82, 85 and 89 have undergone material change and, in most cases, received material additions. Minor corrections and additions appear throughout the book.

I have also appended to each Chapter a selected list of books and articles for further reading. Ebbinghaus' *Grundzüge* (unfortunately not yet completed), James' *Principles*, Külpe's *Outlines* and Wundt's *Grundzüge* are taken as the standard books of reference. My rule, in the citation of other authors, has been to choose the works which, in my opinion, form the necessary nucleus of a working library in Experimental Psychology. Every serious student should possess at least these books, and should moreover have access to the six principal psychological journals. These are: the English *Mind: A Quarterly Review of Psychology and Philosophy* (1876 ff.); the French *Revue philosophique* (1876 ff.); the German *Philosophische Studien* (1881 ff.) and *Zeitschrift für Psychologie und Physiologie der Sinnesorgane* (1890 ff.); and the American *Psychological Review* (1894 ff.) and *The American Journal of Psychology* (1887 ff.).

The references are, in a large proportion of cases, to authors who dissent from the thesis maintained in the text. The teacher is thus enabled, without loss of time, to get both sides of the many disputed psychological questions, and can qualify the statements of the book at pleasure. My own belief — a belief which showed

itself in the absence of outside references from the earlier editions — is that the main thing in teaching elementary psychology is to give one's pupils a system, a consistent body of doctrine. Whether the details are right or wrong is, comparatively, a small matter; errors can always be corrected. But if the beginner finds in psychology a mere medley of conflicting opinion, a hodge-podge of psychological analysis, logical classification, and epistemological interpretation, taken at random from one or another system, he is not likely to attain to clear thinking upon psychological problems. Let him learn a single map first, and only later on enquire how far coast-line and mountain ranges and river courses have been correctly charted. Hence I would suggest to the reader who is reading for himself, and not under instruction, that my references are intended literally for *further*, and not for parallel, reading.

My thanks are due to my wife, to my former pupil, Dr. E. B. Talbot, and to Professor W. G. Smith, of Smith College, for numerous suggestions and corrections. I also owe a heavy debt of gratitude to Dr. I. M. Bentley, my colleague in the Sage School of Philosophy, for constant advice and assistance during the preparation of the new edition.

Finally, it is with very great pleasure that I dedicate this, my first book, — now that it is doing some little measure of service in the psychological world, — to the Regius Professor of Medicine in my old University. It was Sir John Burdon Sanderson who received me, a vagrom philosopher, into the scientific fold; and it was he who, nearly ten years ago, suggested to me the writing of this *Outline*.

CORNELL UNIVERSITY, Ithaca, N.Y.
July, 1899.

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AN OUTLINE OF PSYCHOLOGY

INTRODUCTION

CHAPTER I

The Meaning and Problem of Psychology

§ 1. **Science and Philosophy.** — Knowledge is the product of leisure. The members of a very primitive society have no time to amass knowledge; their days are fully occupied with the provision of the bare necessities of life. But as soon as a community begins to accumulate wealth, and so becomes able to support a leisured class (priests, instructors of rich men's children), an opportunity is created for those who desire knowledge to devote their lives to its acquirement.

Out of this 'curiosity to know' science is born. Men look out upon the world, and see that it is full of objects which call for investigation. Inanimate nature is made to reveal her secrets; laws are discovered in the fall of the stone, the ebb and flow of water, the spread of colours in the rainbow: physics, the 'mother of the sciences,' has arisen. The various living organisms have each their special habits and their special structure, the observation of which is the starting-point of zoölogy; and so on.

Science in its first beginnings, however, is something very different from the science of the modern lecture-room

and laboratory. Man's thought about the world was at first vague and general; the early physicists tried to sum up the whole universe in a single formula, — they had no realisation of the enormous complexity of their problem, of the overwhelming mass of detail that should in later centuries demand the attention of the physical investigator. Thus the old Greek geometer and astronomer, Thales of Miletus (B.C. 640–546), did not hesitate to advance from his special scientific studies to the general statement that "water is the principle of all things." Noticing the different forms that water might assume, solid and liquid and gaseous; remarking the solubility of many substances in water; and finding water essential to the life of plant and animal, — he jumped to the conclusion that the universe is constituted of water, and of water only. So a somewhat later Milesian thinker, Anaximenes, declared that air, the breath of life, is the one reality; earth and water are merely condensations of this, the sole ultimate element of things.

At this stage of man's intellectual history, then, 'knowledge' was a medley of fact and fancy, of observation and speculation. In course of time, however, a sharp line of division came to be drawn between the two spheres of thought, — between 'science' and 'philosophy'; a line the position of which, within the whole of knowledge, is determined by the use of one or other of two *methods* of enquiry. The method of science (so we may say now; we shall be forced to qualify the statement a little, presently) is the method of *analysis*. Physics and zoölogy, and indeed all the sciences, find their source in analysis. What at first seems simple, is shown by careful examination to be compound, and is split up into more simple

parts; these, in their turn, into still simpler; and so on, — until the science has reached its *elements*, the simplest things or processes which belong to it, things and processes which cannot be further reduced or more minutely subdivided. The method of philosophy, on the other hand, is the method of *synthesis*. Metaphysics takes the results of all the separate sciences, and seeks to recombine them into a unity; to show that human knowledge is in reality an organic whole, of which the scientific parts are articulated members. It follows that philosophy becomes less fanciful and more exact, the greater the progress of the sciences; and that any set-back to science must mean either that philosophical thought is also arrested, or that it patches out its gaps by mere guess-work and speculation. It follows, too, that the goal of all intellectual endeavour, the ideal of human thought, — a complete understanding of the world, — consists in an analysis which shall leave no corner of science unexplored and a synthesis which shall leave no single scientific fact unrelated: so that in the end science and philosophy will be united as they were in the beginning, only that their union will be significant, full of meaning, the union of what belongs together, rather than a mere accidental and hap-hazard association.

§ 1 *a*. **The Beginnings of Psychology**. — The first sciences to emerge in definite form from the medley of scientific-philosophical 'knowledge' were those that we speak of to-day as the 'natural sciences.' The first analysis is always analysis of the outward, the external. Just as the infant (whose history is the history of the human race, epitomised, condensed into half-a-dozen years) gets its earliest experiences in the form of experiences of the

things or objects about it, and only after a time attains to self-experience, or comes to speak of itself as 'I,' so mankind at large, at that primitive stage of their development which we are now considering, were attracted to the study of nature and of natural objects. "The understanding," says the English philosopher, John Locke (1632–1704), — and Locke might have used a word of wider significance, and said the 'mind,' — the understanding or the mind, "like the eye, while it makes us see and perceive all other things, takes no notice of itself; and it requires art and pains to set it at a distance, and make it its own object."

But the progress of human thought, though slow and difficult, is sure. Just as natural science takes shape from the preceding natural philosophy, so — though far more slowly — does mental science crystallise out from preceding metaphysical speculation. For let us suppose that the method of analysis, employed in the material sphere, has led to a certain tangible result; that the physicist or zoölogist has collected a large number of observations and arranged them to his satisfaction. It is not to be expected that he will henceforth cease to desire knowledge; for the more we know, the more do we wish to know, "as if increase of appetite had grown by what it fed on." He will rather seek to enlarge the boundaries of his knowledge; to discover new facts, of a different order from those which he has hitherto studied. And at this point the thought may very well occur to him, What is the nature of this *I* which is discovering and arranging? The facts are one thing: he himself, who desires to know about the facts, and who is able to understand and interpret them, is another. Hence he may come to believe that it is worth his while to en-

quire about *himself*, analytically,—just precisely as he has been enquiring about the things outside himself. "Art and pains," it is true, are demanded of him; but the art achieved may be judged worth the pains to be taken for its achievement. "Whatever be the difficulties that lie in the way of this enquiry," so Locke goes on, "sure I am that all the light we can let in upon our own minds, all the acquaintance we can make with our own understandings, will not only be very pleasant, but bring us great advantage." Now when the enquiry has been started, when scientific method has been called upon to answer the question as to the difference between oneself and the things outside oneself, then mental science has sprung into being,—and, foremost among the separate mental sciences, the science of *psychology*.

Psychology, then, is a late development of human knowledge; it does not appear until the sciences of nature have made some progress. And these sciences themselves cannot take shape until mankind has attained a certain stage of civilisation.

Dealers in chemical and physical supplies sometimes issue catalogues with the title "List of Philosophical Instruments." Here 'philosophical' means 'physical'; the phrase is a survival from the time when science and philosophy were not yet sharply differentiated. On the other hand, the word 'philosophical' in popular speech now means 'general, abstract': if we say that a lecturer 'handled his subject philosophically,' we imply that he treated it broadly, from a general standpoint, and did not go into details as the man of science would have done.

Psychology was the first of the mental sciences finally to emancipate herself from the influence of philosophical speculation; though even in our own century Sir William Hamilton (1788–1856) could speak of "metaphysics *or* psychology"! Ethics,

sociology, logic and æsthetics are fast following suit. There remain two philosophical disciplines proper, — two fields to be explored synthetically by a 'science of principles': epistemology, which seeks to answer the question as to the *truth* of our knowledge, and metaphysics or ontology, which seeks to answer the question as to the ultimate *nature* of what we know.

§ 2. **The Definition of Psychology.** — Every one knows in a rough way what it is that psychology deals with. It treats of 'mind' and 'consciousness,' and of the laws of mind and consciousness. My 'mind' is that in me which thinks, understands, reasons, chooses, directs my actions. And my 'consciousness' is my inner knowledge of my thought and action: I am 'conscious' of the awkwardness of my movements, or of the correctness of my answer to an examination question. In these senses, the words 'mind' and 'consciousness' are familiar to all of us.

Now it is quite true that psychology deals with mind and consciousness, and with their laws. But it often happens that the scientific use of words is different from their popular or ordinary use. Thus the word 'law' means, in everyday language, an ordinance or regulation imposed by authority; whereas, in the language of natural science, it means simply a regularity or unbroken uniformity of natural events. It should not be surprising, then, that the 'mind' and 'consciousness' of psychological science differ a little in their meanings from the 'mind' and 'consciousness' of our daily conversation. We shall see, later on, that the current usage of the word is metaphysical as well as psychological.

It will, perhaps, be easiest for us to get rid of our preconceived opinions as to the meanings of these familiar terms, if we have before us, from the very outset, a

scientific definition of psychology, and postpone for the present our discussion of 'mind' and 'consciousness' in their technical psychological senses. Psychology may be defined as the *science of mental processes.* Each of the three terms included in the definition requires a brief explanation.

A *process* is any object of scientific knowledge which is not a 'thing.' A 'thing' is permanent, relatively unchanging, definitely marked off from other things. A process is, by etymology, a 'moving forward.' It is a *becoming something,* — a continuous operation, a progressive change, which the scientific observer can trace throughout its course. It melts into and blends with operations and changes which follow and precede it. Thus the chemist speaks of the 'process of decomposition.' The changes which constitute decomposition are the 'process'; the final products of decomposition are 'things.' The wearing away of a cliff by the action of water is a process; the rock itself is a thing. The thing 'is' here or there; the process 'takes place.' — Psychology deals always with *processes,* and never with things.

A *mental* process is a process in the origination and continuance of which we are ourselves necessarily concerned, — a process the nature of which is determined by the constitution and functions of an organism, an organised individual. Heat, *e.g.*, is a process; but heat, regarded simply as a 'mode of motion,' is independent of us. The movement continues, whether or not a living organism is present to sense the heat. When, however, heat falls within our sensible experience, we, the experiencing individuals, make it what it is. It depends, for its very nature, upon the presence of our living bodies. In other words,

the physical heat movement is *translated* by us (by the structure and function of certain parts of our organism) into the psychological heat sensation. More than that: if we are cold, to start with, the same physical heat will seem hotter to us than it would have done, had we been warm. *This* heat process, then, is a mental process. Or again: the space of geometry is independent of us. It has its laws, which hold good whether we know them or not. But space may be a matter of our experience, and may be modified by our experience. "I had such pleasant thoughts," we may say, "that the road seemed much shorter than usual." *This* space is a mental process. Once more, the process of digestion — essentially bound up as it seems to be with the presence of an organism — is, as a physiological-chemical process, independent of the organism. It may go on in a test-tube as well as in the living body. As mental process (hunger, thirst, 'feeling' of satiety, etc.), on the other hand, it cannot appear apart from our individual organisation. — Psychology deals with none but *mental* processes.

A *science* is a sum of knowledge classified and arranged under certain general rules and comprehensive laws; it is coherent and unified knowledge. We may know, from our boyish discoveries, that the eggs of some gulls and some plovers are speckled with green and brown; but this knowledge is not scientific. It becomes scientific when we include it in the knowledge that the speckling is characteristic of the eggs of the Laridæ and Charadriidæ; and when we use it to link these two groups together, in making out the inter-relations and lines of descent of the different bird forms. — Psychology is not a string of unconnected observations, but a *science*.

(1) Objection may be taken to the statement that the subject-matter of psychology consists exclusively of *processes*. All the text-books of psychology, it may be said, treat of ideas. But ideas are stable, permanent 'things.' I remember now the large chestnut tree that overshadowed my home; I have an idea of the tree. The idea is clear-cut, separate from other ideas which it may call up, — the ideas of the house, of my room in the house, etc. Does not its permanence, and its independence of other ideas, make it a 'thing'?

A close examination of the idea or mental picture of the tree shows us that the objection is not well founded. The idea of the tree is complex, containing a number of colours, a number of lights and shades, a number of forms. These constituents receive varying emphasis during the time of our attention to the idea. Now the form of the tree is uppermost in our mind, now its shadow, now the stickiness of its buds, now some incident connected with it, — the crashing down of a snow-laden branch, or what not. The idea *changes*. Again: the idea of the tree differs according to the different backgrounds of thought upon which it appears. It may be suggested to us by the pain of a bruise, by a patch of colours in a strange landscape, by the sough of the wind on a stormy night, etc. It is not the same in these different cases: it melts to some extent into its mental background, and is continually shifting and moving upon the background. Yet again: the idea of the tree need not always be a mental picture, a visual idea. It may contain the ideas of words, spoken or heard; certain scents, of spring or autumn; certain remembrances of movement or pressure or resistance. All these factors come and go, change places and vary in importance, as the idea passes through the mind. The idea is not a thing: it does not stand, like the rock; it takes place or goes on, like the action of the waves upon the rock. It is a process.

Still, it is always the idea of a *tree*. Yes: just as the process of decomposition can always be called 'decomposition.' The name is permanent (*cf.*, however, § 53); but the name is only one factor out of the whole number which make up the actual mental experience.

(2) It is impossible to give at the outset a complete list even of the typical forms of *mental* processes. Every item of our 'inner' experience — every idea, desire, resolve, emotion, impulse, train of thought, action — is a mental process or a complex of mental processes.

(3) That psychology is a *science* can best be shown by an illustration. Suppose that you are requested to draw upon a piece of paper a circle of the apparent size of the full moon. The words 'draw the circle' arouse a number of ideas in your mind: you think of various occasions when you have seen the moon, you look to see whether the pencil is properly sharpened, etc. When ideas are connected together in this way, each growing out of some one that has preceded it, we speak of a *successive association* of ideas. But there is another set of mental processes involved: those aroused by the gripping of the pencil and its movement over the surface of the paper. When an association of ideas ends with the idea of bodily movement, and this is followed by the sensations which accompany movement, we speak of the total experience as an *action*. The request to draw the circle, then, may be looked upon as a problem in the psychology of action.

When we set to work to analyse this particular action, we find that the circle which we draw is the final result of a very large number of tendencies within us and conditions outside of us. Simple as the request is, each one of us understands it in his own way; and easy as it is to draw a circle, the reasons which lead to *this* drawing are different from those which lead to all the others. Thus one of us may draw 'from memory,' while another has to 'imagine' how the moon looks. And drawing from memory may be of two kinds: the memory may be visual memory, a remembrance of the moon as she appears in the sky, or verbal memory, a remembrance of a statement, somewhere heard or seen, that the moon 'looks as large as a penny,' or 'as large as a dinner plate.' Again: individuals differ in the amount of practice which they have had in 'drawing from memory,' — *i.e.*, in the translation of an idea (the remembered moon) into the movements of hand and arm necessary to reproduce this idea upon paper. Again: the attention may vary, and vary in two ways, during the drawing. It

may vary in steadiness, in 'concentration': the agent may be very attentive to the action, alternately attentive and inattentive, or quite inattentive. It may also vary in direction, while the agent wonders whether the size of the circle is the important thing, and neatness may be neglected, or whether the figure drawn must be an exact geometrical circle; or speculates as to 'what will be done with' the drawings after they are made.

Memory, practice and attention are only some of the subjective factors in the action, factors which may differ in different cases because of differences of internal tendency. We have said nothing at all of a long list of objective factors, due to conditions outside of us. But our analysis, imperfect as it is, is sufficiently complete to indicate two points: that the drawing is, as was stated just now, the final result of a large number of influences; and that these influences — whether they are those of inner tendency or of external condition — can be classified and arranged, can be separately investigated by the psychologist, and can have their due weight assigned them in particular instances. The possibility of analysis and classification shows that psychology may justly lay claim to rank as a science.

§ 3. **Mental Process, Consciousness and Mind.** — Psychology is sometimes defined, technically as well as popularly, as the 'science of mind.' The psychologist can accept this definition, side by side with that just given, if 'mind' is understood to mean simply the sum total of mental processes experienced by the individual during his lifetime. Ideas, feelings, impulses, etc., are mental processes; the whole number of ideas, feelings, impulses, etc., experienced by me during my life constitutes my 'mind.' Mind, as used in everyday conversation, means much more than this: it means something 'immaterial' or 'spiritual,' which shows itself in ideas and feelings, but is really more than those ideas and feelings, — it means a something which 'lies behind' the particular manifestations of

our mental life, just as the *thing* (table, *e.g.*) seems to lie behind the attributes of the thing (the roundness or squareness, size, height, etc., of the particular table). Looked at in this way, however, the term 'mind' takes on metaphysical implications, and therefore has no place in psychology. The question: Is there anything behind the mental process, any permanent mind? and if there is, what is its nature?—is a question which has often been asked, and which it is well worth while to try to answer. But it is not a question which can be raised by psychology. Psychology sees in mind nothing more than the whole sum of mental processes experienced in a single lifetime.

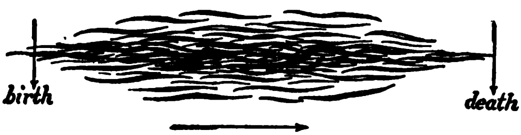

FIG. 1.—*Mind*, represented as the sum total of mental processes experienced by the individual. (For the form of the Fig., see § 35; for processes anterior to birth, § 63; for additions necessary to make the drawing accurate, §§ 32 (2), 38 (2), 81.)

There is, however, a great difference between the mental processes of childhood, vigorous manhood and old age. When we speak of 'psychology,' without any qualifying adjective, we are usually thinking of the psychology of the average human being who has passed beyond childhood, but has not yet become enfeebled by age. Mind, then, as ordinarily regarded by the psychologist, is the sum total of mental processes experienced during this middle stage of life. No definite statement can be made as to the age at which the mind of the child passes over into that of the adult, or that at which the adult mind becomes senile.

It is clear that mind lasts longer than any single men-

tal process; it is a sum or series of mental processes. It must be noted further that the processes which make up mind do not occur one by one; our mental experience, even in moments of extreme preoccupation or concentration, is complex. As you read this page, your mind is composed of a large number of processes: the sense of the printed page; satisfaction or dissatisfaction with that sense; pressures from your clothing, chair, etc.; internal sensations and feelings which make up your bodily comfort or discomfort, which inform you of the position of your limbs, etc.; probably a medley of sounds from neighbouring rooms or from the street, and so on. Just as life consists of a sum of simultaneous processes, — secretion and excretion, circulation and respiration, — so mind is a stream of processes, more or less numerous, which run their course in time together.

My 'consciousness' is the sum of mental processes which make up my experience *now;* it is the mind of any given 'present' time. We might, perhaps, consider it as a cross-section of mind. This section may be either artificial or natural. We may deliberately cut across mind, in order to investigate it for psychological purposes (§§ 9, 33). We have then interfered with the natural succession of our mental processes. On the other hand, mind falls of itself into a series of consciousnesses, each separate consciousness being dominated by some particular group of processes. We enter a scientific lecture room with a science-consciousness; we leave it with a dinner-consciousness; we lay down the day's work with a rest-consciousness. These are natural divisions of mind; they are not so complete and radical as those artificially distinguished, but they

are sufficiently independent of one another for us to recognise their existence in our everyday experience.

The artificial consciousness lasts, as a rule, only for a few seconds. We make our section of mind, glance at the processes in which we are interested, and then move on at once to a new consciousness. The natural consciousness varies in duration from a few seconds to several hours or even days. If a gun is fired unexpectedly outside the window of a room in which I am reading an interesting novel, I have a momentary sound-consciousness, which immediately relapses into the story-consciousness. But if I am anticipating a great joy or sorrow, the group of processes which constitutes the special joy-consciousness or sorrow-consciousness may persist for some length of time.

The natural consciousness, indeed, differs precisely as the time which we speak of as 'the present time' differs. It is 'now' for the whole hour that we spend in the dentist's chair, or for the whole afternoon that we devote to the reading of a new book. For the runner who is awaiting the signal to start, it is 'now' only for two or three seconds. Each of these 'nows' in mental experience is a natural consciousness.

Most analogies and comparisons are in some respects misleading; and our comparison of consciousness to a cross-section of mind is not exempt from criticism. In the first place, the cut, whether natural or artificial, can never be an absolutely clean cut; *some* mental processes will always run over from consciousness to consciousness. Hence a cross-section of mind will always show cut ends, cross-sections of processes actually cut through, as well as 'tails' of processes which are just disappearing. Now, when we examine a consciousness for psychological purposes, we never look at cut ends. The 'looking at' a process while it is still running its course alters the process, and so defeats its own object (§ 9).

The only processes that we can profitably observe are those that are just vanishing at the moment when the cross-section is taken. In the second place, the 'artificial' consciousness is doubly artificial. Not only are its limits arbitrary, not only, *i.e.*, does our cut interfere with the natural flow of our mental processes, but its constituents are also arbitrary. We cannot look at a cross-section with any hope of gaining exact knowledge unless we carefully prepare for it beforehand, arrange that its processes shall be these and these (*cf.* p. 43). From observation of the natural mind we learn, roughly, what kinds of artificial consciousness will be most instructive to us; but the consciousnesses actually observed in psychological investigations are not such as would have occurred in the normal sequence of mental events.

§ 4. **The Problem of Psychology**. — The aim of the psychologist is threefold. He seeks (1) to analyse concrete (actual) mental experience into its simplest components, (2) to discover how these elements combine, what are the laws which govern their combination, and (3) to bring them into connection with their physiological (bodily) conditions.

(1) We saw above that all science begins with analysis. The original material of science is complex; science itself introduces order into chaos by reducing the complex to its elements, by tracing the proportion of identical elements in different complexes, and by determining (where that is possible) the relations of the elements to one another. Psychology is no exception to the rule. Our concrete mental experience, the experience of 'real life,' is always complex. However small a fragment we may seize upon, — a single wish, a single idea, a single resolution, — we find invariably that close inspection of it will reveal its complexity, will show that it is composed of a number of more rudimentary processes. The first object of the psy-

chologist, therefore, is to ascertain the ***nature and number of the mental elements.*** He takes up mental experience, bit by bit, dividing and subdividing, until the division can go no further. When that point is reached, he has found a conscious element.

The mental or conscious elements are those mental processes which cannot be further analysed, which are absolutely simple in nature, and which consequently cannot be reduced, even in part, to other processes. The special reasons which lead the psychologist to look upon various special processes as elements will be discussed in their places, in following chapters.

We have already seen that an 'idea' is a complex process. We may here illustrate the complexity of concrete mental experiences by examining an experience of a different order, — say, an emotion. The emotion of *anger* seems, at first sight, to be a single experience; it has a single name. Really, it is highly complex. It contains, *e.g.*, the idea of the person with whom one is angry; the idea of the act of his, at which one is displeased; the idea of a retaliatory action on one's own part; a mass of bodily sensations, attending the flushing of one's face, the tendency to clench the fist, the bracing of the whole muscular system, — one 'feels stronger' when angry. It begins with a feeling of displeasure, of pained surprise or wounded pride; but this soon gives way to the pleasantness of anger itself, the delight in the idea of retaliation and in the fact that one is strong enough to retaliate, — a delight that has come down to civilised man from his primitive ancestors, and that shows itself continually in the actions of the child. These processes — themselves by no means simple — all take part, crossing and recrossing, shifting and recombining, in the emotion. They need not all be present together in the angry consciousness of a given moment; but all have their share in the experience of anger.

(2) Analysis needs to be tested in two ways. We must always ask, with regard to it: Has it gone as far as it can

go? and: Has it taken account of all the elements which are contained in the experience? To answer the first question, the analysis must be repeated: analysis is its own test. When one psychologist says that a process is elemental, other psychologists repeat his analysis for themselves, trying to carry it further than he could do. If they stop short where he did, he was right; if they find his 'simple' process to be complex, he was wrong. As regards the second question, on the other hand, the test of analysis is *synthesis*. When we have analysed a complex into the elements *a*, *b*, *c*, we test our analysis by trying to put it together again, to get it back from *a*, *b* and *c*. If the complex can be thus restored, the analysis is correct; but if the combination of *a*, *b* and *c* does not give us back the original complex, the analyst has failed to discover some one or more of its ingredients. Hence the psychologist, when he has analysed consciousness, must put together the results of his analysis, must synthetise, and compare his reconstruction of mental experience with the experience as originally given. If the two tally, his work on that mental experience is done, and he can pass on to another; if not, he must repeat his analysis, watching constantly for the factors which he had previously missed.

If the conscious elements were 'things,' the task of reconstruction of an experience would not be difficult. We should put the simple bits of mind together, as the bits of wood are put together in a child's puzzle-map or kindergarten cube. But the conscious elements are 'processes': they do not fit together, side to side and angle to angle; they flow together, mix together, overlapping, reinforcing, modifying or arresting one another, in obedience to certain psychological laws. The psychologist must,

therefore, in the second place, seek to ascertain the *laws which govern the connection of the mental elements.* Knowledge of these laws renders the synthesis of elements into a concrete experience possible, and is of assistance also in subsequent analysis.

When we try for the first time to analyse anger, we may very easily overlook the fourth factor mentioned above, — the mass of sensations accompanying the flush of anger, the doubling of the fist, etc. We discover that we have omitted something, however, as soon as ever we put together the ingredients which we have noticed, and ask if they actually make up the experience of anger, and if they exhaust all that we 'feel' when we are angry. *Something* is still lacking. This discovery shows us that the processes which our analysis has brought to light must somehow have obscured certain other processes, connected with them in the actual emotion. We have now, therefore, to repeat our analysis, keeping a sharp lookout for the missing processes: we shall do well to try to analyse some other emotions, since the processes which are obscure in anger may, perhaps, come to the front in them. After many trials we find what the lacking something is; and our synthesis is satisfactory. At this stage we note carefully the manner in which the items which we missed at first are connected with the other processes in anger, — we seek to determine how they could have been obscured so completely by the other processes. And having made a large number of similar notes, and compared them methodically, we are finally able to write out a law of mental combination or connection. When we have our law, we can apply it in difficult cases as they occur, and so gain help in our later analyses.

We now see why it is that our statement (p. 2) of the *methods* employed by science and philosophy respectively requires qualification. We said that synthesis is the method of philosophy: we find now, however, that synthesis *within a restricted field* of knowledge is part of the method of science. This community of method proves convincingly that science and philosophy are

closely akin, and that philosophy cannot 'transcend' science by any operation of thought peculiar to herself. Philosophy is universal synthesis: science is local analysis and partial synthesis.

(3) Every mental process is connected with a bodily process; we do not know anything of mind apart from body. Mind and body, that is, always go together in our experience. And ordinary observation will convince us that body influences mind in various ways. Consciousness when the eyes are closed is different from consciousness when the eyes are open; if the bodily state varies, the mental state varies also; the dropping of the eyelids prevents the ether waves from gaining access to the sensitive parts of the eyes, and with this physical fact go the mental facts of the sensation of darkness, the 'feeling' of bodily unsteadiness and uncertainty, etc. The mind of a man who has been blind from his birth is essentially different from the mind of one endowed with normal vision. Where the latter sees, the former hears and touches: I *see* my path, but the blind man *hears* and '*feels*' his way. Even the highest and most abstract processes of thought give evidence of the close connection of mind with body. We cannot think, unless we have ideas in which to think; and ideas are built up from impressions received through bodily sense-organs. Thus most of us remember, imagine, dream, and think in terms of sight. When we remember an event, we *see* it occurring 'in our mind's eye'; when we 'imagine' an experience, we have a mental 'image' of it, we seem to *see* it take place; when we dream, we ordinarily *see* ourselves or our friends engaged in this action or in that; and when we think, we often *see* the words in which we are thinking, as if they were printed or written on an imagined page. Psychology is not com-

plete, then, until we have brought the results of our analysis of mental experience, the mental elements, into connection with the *bodily structures and functions* which condition them.

Put in another way, the problem of psychology may be said to consist in the description and explanation of mental processes. Exact *description* implies analysis and synthesis; you cannot describe accurately unless you have taken the object of your description to pieces, observed it in all its parts, and then replaced the parts and reconstructed the whole. When we have described, we can go on to *explain*, to state the circumstances under which the process takes place. Explanation is always that: *the statement of the circumstances or conditions under which the described phenomenon occurs.* The conditions of mental processes are partly mental and partly bodily: the laws of mental connection, on the one hand, and the laws (functions) of certain bodily structures on the other.

The psychologist has to pull mental experience to pieces, — to put it together again, — and to note what happens to the particular processes involved, and what goes on in the body while the experience is in progress. This is the 'problem' of psychology.

§ 5. **The Subdivisions of Psychology.** — Psychology, as we have defined it in § 2, is a single science. It may, nevertheless, present well-marked lines of division within its general sphere, — indeed we have had a hint to this effect in the statement (p. 12) that there are great differences between the child, adult, and senile minds. Hence the question now arises: What are the principal subdivisions of the total science of psychology? How are we to distinguish the special branches of psychological enquiry?

Let us begin with an analogy. We should expect to find a fairly close resemblance between psychology, the

science of mind, and biology, the science of life. Does *biology* show well-marked lines of division? Most certainly it does. Three special sciences are included within the general science of biology. We have (1) *morphology*, the science of structure. Analysis here means dissection, division into parts. The organism is conceived of as a structure, built up from simplest structural elements, 'cells'; and the way in which these elements are arranged in the various 'tissues' is the object of study. We have (2) *physiology*, the science of function. Here the organism is regarded, not as a mass of cells, but as a system of functions, — respiration, circulation, movement, etc. Analysis consists in the reduction of all these functions to their simplest types, the root-functions which are essential to the manifestation of life. We have (3) *embryology*, the science of growth. Attention here is directed upon the sequence of changes, structural and functional both, which mark the persistence of the organism in time. Analysis seeks on the one hand to determine the units of structural change, to show the organism as a series of slightly different cell arrangements, and on the other to reduce to its lowest terms the course of functional development.

Carrying this scheme of division over to the mental sphere, we see at once that the psychology of our definition is (1) a *structural psychology*, an anatomy or morphology of mind. Mind is a mass of tangled processes. Our problem is to dissect this complex, and to discover, if we can, its plan of arrangement. But we may also regard mind (indeed, popular thinking does so regard it: p. 6) as a system of functions. The mind 'does' things for us, or enables us to 'do' things. We shall then have (2) a *functional* psychology. And we may, further, discuss the make-

up and working of the child's mind, and the way in which it passes over into the adult mind. We shall then have a mental embryology. Our psychology has become (3) the study of *psychogenesis*.

It may seem strange, at first sight, that a mind made up of processes should be termed a structure. The word 'structure' suggests something permanent and durable. The word 'process' suggests impermanence and mutation. It should, however, be remembered that the meteorologist speaks of cloud-structures, although to ordinary thought clouds are typically evanescent and insubstantial; that the chemist speaks of the structure of a gas, etc. So we talk of the structure of an argument, a lecture, or what not.

No one of these three psychologies is 'better' psychology — psychology in a more real sense of the word — than any other. But there are very great advantages to be gained by making a thorough study of structural psychology before passing to the study of the functions and the growth of mind. (1) We shall never understand what mind can *do* until we have grasped what mind *is*. "There can be no knowledge of function," writes Herbert Spencer, "without a knowledge of some structure as performing function." The study of anatomy naturally precedes that of physiology. (2) The science of mental structure has made more progress, is in a more settled state, than the other two psychologies. Its methods are more refined; its results more certain. Now, it is of the utmost importance that the student of psychology should learn to *psychologise*. It is not enough to understand a psychological text-book, or to carry the facts of psychology in memory. One must work for oneself, bring oneself up face to face with one's own mental processes, and be able to arrest and observe them. Structural psychology is the *only* psychology that can give this training. The others are still too immature and unsettled. (3) Indeed, it may be doubted whether functional psychology can ever compete with structural in this regard, for the study of mental function is constantly attended by an intellectual danger,

hardly to be avoided even by the trained investigator. The danger is this. When we have found a function, we are tempted to translate the function off-hand into terms of structure. We are likely, unless we are extremely careful, to invent a structure to carry the function. Even to-day, *e.g.*, there are psychologists who speak of a 'sensation of resistance' (*cf.* p. 64). The perception of resistance is a form of mental function; but to speak of a 'sensation of resistance' is as absurd as it would be to speak of a 'circulation' as a part of the body. Circulation belongs to physiology. The corresponding anatomical facts are heart, veins, arteries, blood. All sorts of imaginary processes have been foisted upon the structure of mind by the neglect of psychologists to keep the two enquiries, the anatomical and the functional, distinct.

The psychology with which we shall be most directly concerned in this book, then, is that which studies mind as a structure. We shall, however, appeal to functional and genetic psychology for illustration wherever their discoveries throw light upon the morphology of mind.

Biology deals, however, not only with the life of the individual, but with the life of the species as well. Corresponding to morphology we have *taxonomy*, where the arrangement of species in genera, of genera in families, etc., takes the place of the arrangement of cells in tissues. Corresponding to physiology we have *bionomics*, where the function of species in their natural environment takes the place of the function of organs within an organism. Bionomics enquires, *e.g.*, what forms of animal life accord best with what forms of plant life. It seeks to discover the part played by every species within a given geographical area. Lastly, corresponding to embryology we have *palæontology*, where the problem of the development of species replaces the problem of the development of the single living thing.

Here, again, we find a close resemblance between psychology and biology. Psychology is not limited to the

mind of the individual human being, but extends its scope to treat of the *social* mind, the mental experience of groups of individuals (societies). Nor is it limited to the human mind, but widens out to include the study of the mind of animals. As an instance from taxonomic psychology, we may mention the classification of the emotions (see § 58) given in the *Ethics*, pt. iii., of the Jewish philosopher Spinoza (1632–1677). M. G. le Bon attacks a problem of bionomic psychology in his recent comparison of the Anglo-Saxon and French minds (*The Psychology of Peoples*, 1898). Finally, the student of mental race-development (mental phylogeny) may study the mental life of animals, or may turn his attention to primitive human societies, examining the mind of man in the remote past as manifested in mythology, language, custom, etc. Mythology, *e.g.*, is, as it were, a collection of fossil beliefs, all of which were once living processes in a social mind. Language, again, may be called fossil thought. 'Blue' is the colour of the 'blowing' wind; 'green' the colour of 'growing' vegetation. A knowledge of these and similar relations between words helps us to understand how our primitive ancestors thought.

We shall have little to say of these three psychologies in the present book. Taxonomic and bionomic psychology, indeed, are still in their infancy, hardly more than programmes for the future. And the various genetic psychologies — animal, child and anthropological psychology — have not advanced very far along the scientific road. The work of Charles Darwin (1809–1882) has familiarised us with the idea of evolution or development; and has given us faith in the genetic method, teaching us that we do not fully understand anything until we have found out how it 'grew,' *i.e.*, how it came to be what it now is. The composite plant and the highly organised animal have developed out of

simpler forms of life; and, since man is no exception to the rule, we must suppose that the mind of the adult civilised man has developed out of simpler and yet simpler forms of mind. We may expect, then, that careful study of psychogenesis — by showing us how processes, now highly complex, began in a simple way, and have gradually grown to be what they are — will some day clear up many difficult points, and settle many vexed questions, in the science of psychology as defined by us above. So far, however, the influence has rather been exerted in the opposite direction: psychology has been of more assistance to psychogenesis than *vice versa*. Still, monographs like Professor C. L. Morgan's *Habit and Instinct* (1896), Miss M. Shinn's *Notes on the Development of a Child* (1893–1894), and M. G. Tarde's *Les lois de l'imitation* (1890), are auguries of an approaching change in the relation of the two groups of sciences.

The nature of the assistance which the psychologist may receive from comparative study can be shown by an illustration taken from the psychology of *action*. When we are angry, grieved, etc., — emotionally 'moved,' — we express our emotion by certain bodily movements, known technically as 'expressive movements.' Many of these movements are unintelligible until viewed in the light of mental history, of psychogenesis. Thus the face of proud contempt, "curving a contumelious lip," is only the human copy of the snarl of the dog or wolf. There seems to be no reason why we should curl our upper lip to express scorn; but there is good reason why the animal should do so, — the upward curl lays bare the sharp 'canine' teeth, and is therefore a preparation for actual attack of the enemy. In this case, then, as in many others, the human expressive movement is a survival, in weakened form, of an association (§ 2) which originally served a definite and important purpose in mental life.

§ 6. **Abnormal Psychology.** — Life need not be either complete, or completely healthy life. The living organism may show *defect*, the lack of a limb or a sense-organ or what not; and it may show *disease* or

disorder, a chronic or temporary lapse from normal functioning.

So it is with mind. The blind and deaf show defect of mental structure (p. 19); 'feeble-minded' children show defect of mental function. The dream and hypnotic consciousnesses (p. 149), the consciousness of intoxication, etc., furnish illustrations of mental disorder. And the various types of insanity — mania, melancholia, dementia — are forms of permanent mental derangement.

The study of mental lack and of mental pathology has proved, and will prove, useful to the normal psychologist. Seeing how a mind is constituted *without* some group of elementary processes (sensations of sight or sound), we are better able to estimate the contribution of this particular group to the make-up of the complete mind. It is often said that one does not realise the blessing of health unless one has recently recovered from an illness; health is appreciated by *contrast* with ill-health. The same principle applies in psychology: when we contrast the defective with the full consciousness, we are better able to appreciate what the normal consciousness is, and to understand its constitution and its mechanism or working.

Similarly, the study of insanity brings to light both the nature and the importance of certain normal processes. "Prevention is better than cure." But prevention is possible only after a long series of particular cures has been performed. The different diseases show us what conditions are favourable to health, and what are unfavourable; and we learn to avoid over-eating, cold draughts, etc. In other words, the different diseases help us to *analyse* health into a number of factors: good diges-

tion, uniform temperature, moderate exercise. In just the same way, the occurrence of various forms of mental disease helps us to analyse the normal consciousness; we see what kinds of processes are grouped together, and what processes are relatively independent; and we may have factors brought under our notice which would have escaped us altogether in the normal mind, because masked or obscured by the presence of other processes. As the first business of the psychologist is analysis, this assistance from mental pathology is very important.

A case of blind-deaf-mutism, like that of Laura Bridgman,[1] is, so to speak, a psychological experiment made for us by Nature herself. When we observe how a mind works, which lacks the perceptions of sight and hearing, and the sensations accompanying the movements of speech, we can estimate the place which these sensations and perceptions occupy in our own conscious life; and the makeshifts of the defective mind, the various ways in which the processes remaining to compose it are made to do double or triple duty, give us welcome hints as to the hidden resources and obscurer functions of our own fuller and richer consciousness. Or again: suppose that a man, blind from his birth, is rendered able to see by a surgical operation. He must learn to use his eyes, as a child learns to walk. And the gradual perfecting of his vision, the mistakes and confusions to which he is liable, all the details of his visual education, form a storehouse of facts upon which the

[1] Laura Dewey Bridgman was born in 1829 at Hanover, New Hampshire, and died in 1889, at the Perkins Institution for the Blind, Boston, Massachusetts. An attack of scarlet fever at the age of two years deprived her of hearing and of the sight of her left eye, while it greatly impaired the senses of smell and taste. Speech was lost with the loss of hearing; and the sight of the right eye disappeared entirely six years after the illness.

A special system of education was devised for Laura Bridgman, and extended from 1837 to 1850. From the reports of her mental development during this period, and from examinations of her capacities made at a later date, much valuable psychological information has been obtained.

psychologist can draw, when he seeks to illustrate the development of the perception of space in the normal mind, — the manner in which we come to judge of the distance of objects from one another, of their direction, and of their size and shape. Once more: those forms of mental unsoundness which consist in the decay or derangement of a single group of processes are of great use to the psychologist. They show him how the mind works without that particular group, or how it works when the group occupies too large and prominent a place in the field of consciousness; and thus enable him to trace its normal function in the healthy mind. What is called 'agoraphobia' — a morbid fear of being alone in open spaces, of crossing a street, etc. — is only an exaggerated form of an experience which most of us have had, the experience of 'losing our head,' when we pass suddenly from a quiet country life to the bustle of a large town; and the study of this experience 'writ large' in agoraphobia will help us to understand it as printed small and stamped lightly upon our own consciousness. So the exaggerated self-importance of paranoia throws light upon the state of mind which we describe by saying that we were 'self-conscious' upon some social or public occasion.

Disorders of the *social* mind can be studied in the various panics, epidemics of false belief, etc., which occur from time to time even in the most highly civilised societies. The mob consciousness stands to a healthy social consciousness very much as dreaming to the waking life. Disease of the social mind means the downfall of society. Thus the Chinese, at the beginning of the war with Japan, may be said to have been affected by a national paralytic dementia.

§ 6*a*. **The 'New' Psychology and its Relations.** — Scientific psychology is a creation of the present century. It differs in three principal ways from the speculative psychology which preceded it. (1) It has freed itself entirely from the influence of philosophy (epistemology and metaphysics), and it has done this most effectually by its insistence that mind is to be examined as a *structure*, and not merely as a

group of functions. Locke, in his famous *Essay concerning Human Uuderstanding*, defined idea as 'whatsoever is the object of the understanding when a man thinks,'—'that which the mind is applied about whilst thinking.' This is very different from our own view of 'idea' as a complex of sensations (p. 158). (2) It has introduced experimentation into the study of mental processes. It insists that the psychological method of introspection (§ 9) shall be employed under 'experimental' conditions,—that is, under conditions which reduce the possibility of mistakes to a minimum, and which enable one enquirer to test or check the work of another by exactly repeating it for himself (§§ 9, 10). This reform of method constitutes so radical a departure from psychological tradition that modern psychology is sometimes termed outright 'experimental psychology.' (3) It seeks to bring mental process into close and accurate relation to the underlying bodily process (p. 19). In the pursuance of this aim two new sciences, intermediate between psychology and physiology, have taken shape: physiological psychology and psychophysics. *Physiological psychology* is both wider and narrower than experimental psychology. It is wider in that it demands a detailed knowledge of certain parts of physiology (the physiology of the central nervous system and of the sense-organs attached to it); and it is narrower in that it employs no methods of investigation except those which are followed in the physiological laboratory. *Psychophysics* is the science of the relation of mind to body. It lays precisely equal weight upon the mental process and the bodily process connected with it. The psychophysicist desires to know exactly how mind is related to body, and body to mind. He gets his facts or data both from the

psychologist (number and nature of the mental elements, laws of mental connection) and the anatomist and physiologist (structure and function of the various parts and organs of the body). His aim is to bring the two sets of facts, the mental and bodily, into connection with each other; to discover the *laws* of the connection.

It will be seen that the problem of psychophysics is identical with the last of the three special enquiries which make up the problem of psychology. The psychologist can borrow facts from the psychophysicist, therefore, as well as the psychophysicist from the psychologist. But though the problem may be identical in the two cases, the standpoint of the enquirers is different. The psychophysicist examines the relation of mind to body for its own sake: when he knows the relation, his work is over. The psychologist examines the relation from the side of mind, and uses it to assist him in his explanation of mental phenomena.

In just the same way, the problem of psychophysics is part of the problem of physiology. The standpoint differs again, however: the physiologist looks at the relation between body and mind from the side of body, and uses it to assist him in his explanation of the phenomena of life. To the psychophysicist, knowledge of the relation is an *end;* to the physiologist, as to the psychologist, it is only a *means* to an end.

It is clear that this scientific psychology is closely connected with certain other sciences, and may hope to derive assistance from them in its attempt to describe and explain the facts of our mental life. The sciences to which we shall most naturally appeal for help are those of physiology, physics, and mathematics.

(1) As regards physiology, the reader need only be reminded that one of the aims of the psychologist is to bring the simplest mental processes into connection with the bodily processes which they accompany. It is clear

that he cannot accomplish this task, unless he have some knowledge of the different bodily organs, of the way in which they work together for various purposes, and of the part they play in the life of the whole organism.

Illustrations of the way in which physiology can aid psychology will be found throughout the following chapters of this book. One instance may suffice here.

The psychological investigation of feeling (pleasantness and unpleasantness) is very difficult. Fortunately, every feeling has various bodily manifestations, in breathing, play of feature, etc., so that we can follow the course of a pleasure or disagreeableness by noting its physiological symptoms. Now, it has been found that the bodily manifestations of the 'higher' feelings — joy, the pleasure of success, the pleasure of the performance of a duty; or shame, scorn, the dissatisfaction which follows failure — are the same as the bodily manifestations of the 'lower' feelings, — the pleasure of a good meal, or the unpleasantness of bodily pain. Here is welcome confirmation of the conclusion reached, but reached with great difficulty, by introspection: that the conscious processes of pleasantness and unpleasantness are the same, in whatever mental setting they occur, *i.e.*, with whatever other mental processes they are connected.

(2) A knowledge of physics will aid the psychologist to regulate the material conditions of his experiments, to sift out accurate from inaccurate results, to avoid reading into the structure of mind peculiarities which inhere in the structure of his apparatus. And (3) mathematics will aid him to formulate in brief and perspicuous terms the settled methods of psychological research, the different laws of mental connection, etc.

The reader must not think that a thorough knowledge of these three related sciences is *essential* to psychology. A man may be a good psychologist, and yet have but a superficial acquaintance with

any one of them. Only, the more of them all he knows, the more and the better tools has he wherewith to handle his psychological problems, — the farther will he be able to push his analyses, and the more exhaustive will be his subsequent synthesis.

The work of the German philosopher and psychologist, J. F. Herbart (1776–1841), forms the dividing line between the old and the new psychologies. The founders of modern psychology are: the psychophysicist, physiologist and anatomist, E. H. Weber (1795–1878), late professor of physiology at Leipzig, author of *Tastsinn und Gemeingefühl* (1846), etc. (*cf.* p. 89, *infra*); the philosopher, psychophysicist and physicist, G. T. Fechner (1801–1887), late professor of physics at Leipzig, author of *Elemente der Psychophysik* (1860), etc.; the philosopher, psychologist and physiologist, R. H. Lotze (1817–1881), late professor of philosophy at Göttingen, author of *Medizinische Psychologie* (1852); the psychologist, physiologist and physicist, H. L. F. von Helmholtz (1821–1894), late professor of physics at Berlin, author of *Handbuch der physiologischen Optik* (1856–1866) and of *Die Lehre von den Tonempfindungen* (1862: trans. by A. J. Ellis, 3d edn., 1895); and the philosopher, psychologist and physiologist, W. M. Wundt (born 1832), professor of philosophy at Leipzig (where he founded the first psychological laboratory in 1878–1879), author of *Grundzüge der physiologischen Psychologie* (1874; 4th edn., 1893), etc.

References for Further Reading

H. Ebbinghaus, *Grundzüge der Psychologie*, Vol. I, §§ 1–5, 12.

W. James, *The Principles of Psychology*, Vol. I, chs. i, ix.

O. Külpe, *Outlines of Psychology*, §§ 1, 3.

A. Seth, art. *Philosophy*, in *Encyc. Brit.*, 9th edn.

W. Wundt, *Grundzüge d. physiol. Psychologie*, 4th edn., Vol. I *Einleitung*; Vol. II, ch. xix (§§ 1, 4).

For *physiology* in its relation to psychology, see Ebbinghaus, I, §§ 7–11; James, I, ii, iii; Wundt, I, i–vi; *cf.* p. 157 below.

For the character of mind as *process*, see Wundt, *Philosophische Studien*, X, pp. 121–124 (1894).

PART I

CHAPTER II

SENSATION AS A CONSCIOUS ELEMENT. THE METHOD OF INVESTIGATING SENSATION

§ 7. **The Definition of Sensation.** — We have seen that 'thinking' cannot go on without ideas. When I am thinking about anything, my consciousness consists of a number of ideas, some running their course side by side, and others following these in obedience to the laws of association. We have seen also that we cannot have certain ideas unless the body possesses certain organs; 'memory' and 'imagination,' *e.g.*, are very largely made up, for most of us, of visual ideas, — and these imply the existence of the eye.

Ideas are always complex, made up of simpler factors. Our way of using a single word to express them — though there are good reasons for it — is likely to mislead us upon this matter: it tempts us to think that they are simple and uniform in their nature. Hence it requires some effort and trouble to analyse an idea, even if (as is often the case) it owes its existence to the combined action of several sense-organs. But every idea can be resolved into elements, *i.e.*, elemental *processes;* and these elements are termed *sensations.*

My idea of a particular book is an idea derived from the cooperation of several bodily organs. It may include at any moment the look of the book (eye), the sound of its contents when read

aloud (ear), its weight (skin, etc.), and the scent of its cover (nose). Now let us leave out of account all the constituents of the idea except those which come from the eye. We have remaining the red of the leather and gold of the lettering on the cover, and the black and white of the printed pages. Each of these quite simple components of the idea is a *sensation* of sight. Or let us leave out of account all the constituents except those coming through the ear. We then have the sounds of a familiar voice, which we imagine to be speaking certain successions of words. Each word uttered has a particular pitch, is a particular musical tone; while at the same time its consonants are heard as noises or auditory shocks. These quite simple processes — the simple tone and the simple noise — are *sensations* of hearing. Or again: let us leave out of account all the components of the idea except the weight which we remember that the volume has when we hold it up. This weight includes a pressure on the skin of the hand, a pull or strain upon the tendons which hold the muscles of the arm to their bones, and a jamming together of the bones themselves at wrist and elbow-joint. Each constituent — skin pressure, tendinous strain, articular (joint) pressure — is a quite simple process, which cannot be further analysed. We speak, therefore, of *sensations* of pressure and of strain.

We have now split up the apparently simple 'book' into a large number of really simple sensations. The analysis was not easy, even though different bodily organs were concerned in the idea: it would be difficult to say, for instance, just what is due, in the idea of 'weight,' to joint, what to sinew, and what to skin. The analysis becomes very much more difficult when all the components of the idea come from the same sense-organ. Long practice is required before one can analyse the note of a musical instrument into the separate simple tones which it contains. But the analysis is always possible.

We may compare the sensation, the element of the idea, to the elements treated of in chemical science. The idea is a compound; it consists of a number of elemental

processes, travelling side by side in consciousness: it therefore resembles the compound bodies analysed in the chemical laboratory. But the sensation resists analysis, just as do the chemical elements oxygen and hydrogen. It stands to the idea as oxygen and hydrogen stand to water. Whatever test we put it to, — however persistent our attempt at analysis and however refined our method of investigation, — we end where we began: the sensation remains precisely what it was before we attacked it. 'Cold,' 'blue,' 'salt,' cannot be divided up into any simpler modes of experience.

All sensations come to us from definite bodily organs: cold from the temperature organs in the skin, blue from the sensitive organs in the retina of the eye, salt from sensitive cells planted in the mucous membrane of the tongue. These 'peripheral' organs — organs at the periphery or on the surface of the body — are united, by nerve-fibres, to the supreme 'central' organ, the brain. The peripheral organs of temperature are united to one group of cells in the cortex (the grey covering matter) of the hemispheres of the brain; the retina of the eye to another; the peripheral taste-cells to a third. The bodily process with which sensation is connected is, therefore, twofold: it consists of a stimulation of the peripheral organ, and a consequent excitation (carried inwards by nerve-fibres) of the central organ.

Our definition of sensation must take account of its simplicity as a conscious process (first part of the problem of psychology: § 4) and of its bodily conditions (third part of the problem). It will run as follows: Sensations are those elemental conscious processes which are connected with bodily processes in definite bodily organs.

We cannot get *any* sensation until the peripheral organ has been stimulated. Those unfortunates who are born blind or deaf, who have no peripheral organs which can be stimulated, possess no sensations of sight or hearing at all. It is a mistake to suppose that they live in darkness and silence. To appreciate darkness and silence we must be able to see and hear; darkness is a sensation of sight, and silence is in reality a very faint sensation of sound, — the sensation received from the pumping of blood through the arteries of the ear. Those born deaf or blind do not hear or see *anything*.

But when the peripheral organ has been stimulated some few times, its stimulation ceases to be necessary to the production of a sensation. The central excitation (set up somehow within the brain) is enough. We can 'remember' a yellow, when our eyes are shut; we can 'imagine' a cold draught, when our skin is thoroughly warm. The bodily processes connected with the remembered yellow and the imagined cold are central only, not peripheral: but the yellow and the cold, as mental processes, are none the less *sensations*.

"They are different from real sensations, however, — different from sensations set up by actual stimulation of the eye and skin," it may be said: "we know that they are only remembered or imagined, and not sensed." That is true: but the difference does not lie in the nature of the processes themselves. A remembered 'yellow' and a seen 'yellow' are just the same as sensations, as 'yellows.' If the remembered yellow seems to lack something of the seen yellow, that is only because its intensity is less, its outline not so distinct, its conscious course more rapid. Really, however, the 'remembered yellow' is a more complex process than the seen yellow: it is a yellow *plus* what we may call the memory-mark. So an imagined cold is a sensation of cold *plus* the imagination-mark. The processes which make up these marks will be analysed later on (Ch. XI).

§ 8. **The Attributes of Sensation.** — Although the sensation is an element of mind, that is, a process which cannot be split up into simpler processes, yet it has various

aspects or attributes — presents different sides, so to speak — each of which may be separately examined by the psychologist. Some sensations have four such aspects; every sensation has at least three. The four are quality, intensity, extent and duration. The process is *itself*, and not some other process (quality); it is stronger or weaker than other sensations (intensity); it spreads over a certain portion of space, greater or less (extent); and it lasts a certain, longer or shorter period of time (duration).

Suppose that I have a tuning-fork, which gives the pitch of the concert *a*. I may strike it gently or roughly. In each case, the 'tone' remains the same, the quality is that of the musical *a*; but the tone produced by the second blow is louder, more intensive, than that produced by the gentle tap. Again: I may let the tone 'run down' or 'ring off,' or I may stop or 'damp' it by laying my finger upon the vibrating prongs a second or two after I have struck the fork. The tone is still the same; its duration differs. This tone sensation, then, possesses quality (the pitch of a musical *a* in a certain octave of the scale), intensity (loudness or softness) and duration (more or less time for the running its course in consciousness). It has no extent, since sounds, though they come to us through space, do not fill space, and therefore cannot be compared as regards size. A bass note, though it may have more 'volume' (as we say) than a treble note, is not larger than the treble note, in the sense in which the red quality of a peony is larger, more extended than the same quality in a rose.

Had we taken as our illustration this sensation of colour from the eye, or a sensation of pressure upon the skin, we should have found the attribute of extent present in it. No point of coloured light is so small that it has no length or breadth: and no needle-prick is so fine that it does not represent in consciousness some extent of skin. Extent is an invariable property of visual and cutaneous (skin) pressure sensations.

We may represent a four-attribute sensation in the form indicated by Fig. 2. It must be noted that all the aspects

(three or four) which a particular sensation can present are, as a matter of fact, always presented together in consciousness. If any one of them disappears, the whole sensation disappears with it. A tone which is of no duration, which does not last for any time at all, is not a tone; and a point of light which has no extent cannot give rise to a sensation of sight,—it is just nothing.

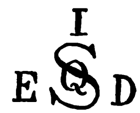

FIG. 2.

The quality of a sensation is the attribute which distinguishes it from every other sensation. And it is quality which makes sensation an elemental conscious process. The fact that one process is stronger or weaker than another, lasts a longer or shorter time, is more or less extended, could never tell us whether it was itself simple or complex. But every quality is radically different from every other quality: it always remains itself, through all changes of intensity and of time or space. An *a* in music may vary in loudness and in duration; but it is still *a*, and therefore different from all the other tones, *b*, *c*, etc. A blue may show itself as a flash or as a permanent illumination; it may be a point or a broad colour surface: but its blueness differentiates it from all other visual sensations. Quality, that is, is the most important and fundamental of the sensation attributes: it constitutes what we might call the core or kernel of the sensation,—though we must not allow the phrase to mislead us, by suggesting that the sensation is a compound process. We might express the fact equally well, perhaps, by saying that sensation intensity is always the intensity of a certain quality; sensation duration always the duration of a certain quality, etc.

Quite complex processes may possess their own intensity, duration and extent. Thus a note struck upon the piano, which com-

prises several sensations of simple tone, may be spoken of as 'loud' or 'soft'; the taste of a refreshing draught of lemonade may linger in the mouth for a longer or shorter time; and the Sistine Madonna may be imagined as of any size, from that of the original painting to that of a small cabinet photograph. But no complex idea has a single quality. Even if it seems single to the untrained observer, — as the piano note may do, — it can be resolved by practice into its really simple elements (sensation qualities).

How it comes about that a complex process may have a 'total' intensity, duration, etc., distinct from the intensities and durations of the sensations composing it, will be explained later on (§§ 39, 43 ff.).

§ 9. **The Method of Investigating Sensation.** — Every science has its own special material to deal with, and consequently its own special methods of working upon that material for the discovery of facts and laws. Physics and chemistry follow 'physical' and 'chemical' methods: and no progress can be made by the student in either science until he has learned the right *way* to work, *i.e.*, has grasped the significance of method. The special method employed by psychology is that of *introspection* or self-observation. We 'look into' the mind, each for himself; or we observe ourselves, — in order to find out what processes are going on at the time, and how they are influencing one another.

This 'looking into' one's mind or observation of one's own mental processes must not be understood literally, however, as if consciousness were one thing, existing of itself, and the 'I,' the observer, could stand apart and watch it from the outside. The 'I,' the watching, and the conscious phenomenon observed, are all alike conscious processes; so that when 'I observe myself,' all that

happens is that a new set of processes is introduced into the consciousness of the moment.

But this introduction of new processes must, it would seem, bring about a change in the particular experience which one sets out to observe. And it is imperative to keep that experience unchanged: a method of observation which involved an alteration of the facts to be observed would not be worth much. Direct introspection — observation of a process which is still running its course — is, as a matter of fact, entirely worthless; it defeats its own object.

Suppose, *e.g.*, that I am absorbed in the enjoyment of a humorous story or a musical composition, and suddenly (remembering that I am interested in psychology) ask myself what my enjoyment is, and what mental processes go to make it up. I find myself baffled: the putting of the question has seriously altered my consciousness. I cannot enjoy and examine my enjoyment at one and the same time.

Psychological introspection, however, does not consist in the effort to follow up a process during its course. The rule for introspection, in the sphere of sensation, is as follows: *Be as attentive as possible to the object or process which gives rise to the sensation, and, when the object is removed or the process completed, recall the sensation by an act of memory as vividly and completely as you can.*

The object or process which gives rise to a sensation is termed the *stimulus* to that sensation. If we attend to the stimulus, the sensation becomes clearer, and has a more enduring place in consciousness than it would have gained in its own right. Hence we can best observe those sensations to whose stimuli we have been especially at-

tentive. We avoid any interference with the mechanism of consciousness by postponing our observation of the process which we wish to examine until after it has run its full course, and the stimulus which occasioned it has ceased to affect us. We then call it back, look at it from all points of view, and dissect it. Introspective examination must be a *post mortem* examination.

A comparison may help to make the meaning of the rule clear. We may liken the consciousness upon which the stimulus works to sealing-wax, and the stimulus itself to the signet stone impressed upon it. Attention prepares the mind for the reception of an impression, as the heating of the wax prepares it for the signet; and the more attentive we are to the stimulus, the deeper is the impression which it makes upon us. The impression once made, the wax hardens: we can recall the sensation, scrutinise it, trace the course which it followed, etc., — just as we can hold up the hardened seal to the light, note the pattern, the flaws in the wax, etc., in a way which is impossible during the stage of softness, when the stone produces its greatest effect.

But this introspection, it may well be said, cannot furnish very reliable results. The individual can apply the method to one consciousness only — his own; and we all know how easy it is for a single observer to make mistakes, and how necessary to have more witnesses than one, if a fact is to be securely established. There is no guarantee that other individuals would come to the same conclusion, from an examination of their consciousnesses; and no means of comparing the conclusions reached by different individuals under similar circumstances.

The first objection is unanswerable. But although we can never apply the introspective method to any consciousness except our own, we can arrange matters so that other

individuals may be brought forward as witnesses to the facts which we ourselves have observed. This end is attained by the employment of the method under *experimental* conditions.

An experiment is a trial, test, or observation, carefully made under certain special conditions: the object of the conditions being (1) to render it possible for any one who will to *repeat* the test, in the exact manner in which it was first performed, and (2) to help the observer to rule out disturbing influences during his observation, and so to get at the desired result in a *pure* form. If we say precisely how we have worked, other investigators can go through the same processes, and judge whether our conclusion is right or wrong; and if we do the work in a fitting place, with fitting instruments, without hurry or interruption, guarding against any influence which is foreign to the matter in hand, and which might conceivably alter our observation, we may be sure of obtaining 'pure' results, results which follow directly from the conditions laid down by us, and are not due to the operation of any unforeseen or unregulated causes. Experiment thus secures accuracy of observation, and the connection of every result with its own conditions; while it enables observers in all parts of the world to work together upon one and the same psychological problem.

The psychological experiment does not differ in any essential respect from the experiments of the other sciences, — physics, physiology, etc. There is always the one difference already mentioned: while a newly discovered insect or a rare mineral can be packed in a box, and sent by one investigator to another in a distant country, the psychologist can never put his consciousness in any

similar way at the disposal of his fellow-psychologist. But the difference is a minor difference: it does not extend to the nature and function of the experiment itself, — it does not impair the accuracy of psychological results or prevent community of psychological investigation.

The rule of experimental introspection, in the sphere of sensation, runs as follows: *Have yourself placed under such conditions that there is as little likelihood as possible of external interference with the test to be made. Attend to the stimulus, and, when it is removed, recall the sensation by an act of memory. Give a verbal account of the processes constituting your consciousness of the stimulus.* The account must be written down by the assistant, who has arranged for you the conditions under which the test is to be made. His description of the conditions, and your description of the experience, furnish data from which other psychologists can work.

In whichever form it is employed, the introspective method demands the exercise of *memory*. Care must therefore be taken to work with memory at its best: the interval of time which elapses between experience and the account of experience must not be so short that memory has not time to recover the experience, or so long that the experience has become faded and blurred. In its experimental form, introspection demands further an exact use of *language*. The terms chosen to describe the experience must be definite, sharp and concrete. The conscious process is like a fresco, painted in great sweeps of colour and with all sorts of intermediary and mediating lights and shades: words are little blocks of stone, to be used in the composition of a mosaic. If we are required to represent the fresco by a mosaic, we must see to it that our blocks be of small size and of every obtainable tint and hue. Otherwise, our representation will not come very near to the original.

Introspection is the sole method by which we can investigate the facts and laws of sensation. It may be used wrongly, as when we try to observe a sensation during its progress; it may be used imperfectly, as when we employ it under varying conditions, or give an incomplete account of our experience, or work at a time when the memory is fatigued; and it may be used rightly, under experimental conditions and safeguards. But, however we use it, it is the sole method which we can follow.

When we pass from the first and second parts to the third part of the problem of psychology (§ 4), — when we ask, not what are the facts and laws of sensation as revealed by introspection, but what are the bodily processes which accompany sensation processes, — we must, of course, accept the account of the body and its workings which is offered by physiologists and biologists, and which has been obtained by the use of the methods peculiar to physiology and biology. The union of physiological and psychological methods for psychophysical purposes has led to the formulation of a number of 'psychophysical methods' (§ 6 *a*). Since we, as psychologists, are using psychophysics only as means to an end, as an aid to our understanding of mind, it is unnecessary for us to give a full and detailed statement of psychophysical methods in this book. Many of them will be briefly indicated in the Sections in which we enquire into the bodily concomitants of the elemental conscious processes.

§ 10. **General Rules for the Introspection of Sensation.** — The 'experimental conditions' which are necessary to render the results of introspection scientifically valuable will, of course, differ in the case of different sensations. The rules which apply in the sense of sight do not hold, without modification, in that of hearing. But there are certain conditions which must always be regarded, in whatever department of sensation we are working: or to

put the matter from the other side, there are certain errors to which we are always liable, and which we must constantly guard against.

(1) When we introspect, we must be absolutely *impartial* and unprejudiced. We must not let ourselves be biassed by any preconceived idea. We are likely to think that, in all probability, a certain thing will happen, or we may actually want to obtain a given result, to confirm some view which we have already formed. In either case, we are in danger of mistaken observation. We ought to be ready to take the facts precisely as they are.

Impartiality is a necessary condition of all scientific observation. We observe because we are interested in the result of our observation: some chance occurrence has suggested to us an explanation of particular events, and we are interested to discover, by systematic enquiry, whether the explanation is correct. The trained observer, psychologist or physicist or what not, can take the suggestion for what it is worth; he does not allow it to affect his observation. But the beginner is exceedingly liable to be led by interest into partiality; and so to see, not what really happens, but what he desires or expects to see happen.

Impartiality in psychological investigations, however, is peculiarly difficult. In most sciences, the danger of partiality begins after a few accidental observations have suggested a certain view. In the case of (1) animal and child psychology, the bias may exist before any observation has been made at all, and all observations, from the very first, be vitiated by it. Mother and nurse find intelligence in the baby when the disinterested observer can see nothing out of the common; and lovers of animals tell wonderful tales of the intelligence of their special pets. In the case of (2) adult human psychology, bias may also be prior to any observation. A certain resoluteness and evenness of disposition, a moral steadiness and balance, are required of the introspective psychologist. It is not only that "what ardently we wish we soon be-

lieve" : the chemist runs that danger equally with the psychologist. It is rather that the objects of investigation are intrinsically elusive, that their investigation demands both quickness and accuracy, and that the observer has to forget all social relations and take up a sturdily independent attitude to facts which are (in the sense of § 2) of his own making. Many people are too complaisant, too reflective (letting reflection about experience take the place of experience itself), too impressionable, etc., to be impartial.

To get at facts, we must be wholly unprejudiced : interested in the general subject, but not concerned to establish a particular result.

(2) When we introspect, we must have our *attention* under control. The attention must not be permitted either to flag or to wander.

The reasons for this rule have been given above. The better we attend to an occurrence, the more accurate and lasting is our memory of it.

It is difficult for the beginner to control his attention. In the first place, he has not learned by experience what exactly it is that he is required to attend to, and so is liable to be distracted by what are really accidental and irrelevant stimuli. And when this difficulty is overcome, there is still the danger that the attention may wander or flag. The observer will be apt to interrupt his introspection, asking himself whether he is carrying out instructions, whether his attention is at full strain, what is the meaning of this or that condition of the experiment, etc. Practice is the only remedy for these faults; and even practice cannot secure an unflagging attention, if the observation be too long continued.

(3) When we introspect, body and mind must be *fresh*.

Fatigue and exhaustion prevent any sustained concentration of the attention. We cannot attend if we are sleepy, or if we have worked our muscles to the state of pain and stiffness. And if we cannot attend, we cannot introspect.

It follows that we can introspect best in the morning; or, if

morning hours are not available, in the late afternoon, after refreshment by moderate exercise. Introspection should not be attempted immediately after eating, *i.e.*, at a time when we are normally sleepy. It follows also (1) that if a psychological investigation promises to be at all long, we should work upon it rather for a short time daily during a number of days than for any length of time together during a few days, and (2) that we should work at the same hour of each day. The first rule provides against fatigue during a single sitting, the second keeps the conditions of freshness and tiredness constant from day to day.

(4) When we introspect, our *general disposition*, physical and mental, should be favourable. We must feel well, feel comfortable, feel good-tempered, and feel interested in the subject.

Any physical or mental discomfort hinders introspection: breathlessness, a cold in the head, a too hot room, a strained attitude of the body (as when one sits in a low chair at a high table); or irritation at having to work at this particular time, self-consciousness, nervousness (anxiety as to whether one is working correctly, as well as one's neighbour, etc.), impatience, disbelief in the value of the special experiment, dislike of those with whom one is associated to perform it, the disregard which comes from frequent repetition of a certain act of introspection and the contempt which is bred by familiarity with its conditions, etc. It is difficult to be sure that our results are obtained under the most favourable conditions of physical and mental disposition; but no others are really trustworthy.

These are the most important of the general rules to be followed in introspection. Can we ever be quite sure that we have followed them?

Even when we think that all possible precautions have been taken, it must often be the case that certain of the required conditions are left unfulfilled. However favourable the general disposition, *e.g.*, and however trained the

power of observation, there may still be some unnoticed wavering of the attention, some unsuspected tinge of preconceived opinion. While, therefore, we may reasonably hope to get perfectly correct results in many instances, we cannot be sure that the single result of any particular experiment is entirely free from error. Now there is a method, employed both in science and in practical life, which helps us to set up a working standard, a norm with which all individual results may be compared, under the most various and fluctuating circumstances: the method of *averages.* We make a large number of observations, and take their average. This mean result will not represent the observer at his very best, but will indicate the normal or average performance which may be expected of him when the conditions under which he observes are as favourable as human nature can make and keep them. The average lies, *i.e.*, somewhere between the result obtained under absolutely favourable conditions and that gained under conditions which just fall short of being entirely favourable. The more highly trained the observer, the greater his impartiality, and the better his general disposition, the more nearly will the average approach to the ideal standard.

The method of averages is always employed in psychological experimentation. Oftentimes the average is brought exceedingly near the ideal result by the fact that the errors of the separate experiments cancel one another when the average is struck, — as many falling on the *plus* side as fall upon the *minus* side.

The 'facts' of the psychology of sensation are, then, average results obtained from observers trained in introspection under experimental conditions of both a general

and a special character. The former we have learned to know as impartiality, attention, freshness, and favourable disposition. The latter we shall discuss (under the heading of *Method*) in following chapters.

§ 11. **The Classification of Sensations.** — Every sensation comes to us from a definite bodily organ. We may therefore divide sensations into groups or classes, according to the various *sense-organs* which the body possesses, and speak of eye sensations, ear sensations, nose sensations, skin sensations, muscle sensations, joint sensations, etc.

This list, if completed, would be perfectly accurate. But it is convenient to make some further divisions and subdivisions, which are justified by differences in the nature of the stimuli necessary to arouse sensations of certain kinds. Classification by *stimulus*, in addition to the classification by sense-organs, is useful in two ways.

(1) Sensations in general fall into two principal groups, according as their stimulus is external (originating outside the body) or internal (originating within the body). Light, the stimulus to vision, is an external stimulus; muscular contraction, the stimulus to muscular sensation, is an internal stimulus. We therefore distinguish between *sensations of the special senses*, which are stimulated from without, and *organic sensations*, the stimulus to which consists in a certain state, or change of state, of the internal bodily organ from which they come. There is, probably, no sensation quality which is common to every department of sense, internal and external alike; though pain has, until quite recently, been generally regarded as a *common sensation* of this kind.

(2) The nature of the stimulus may differ within the same sense. Light is the stimulus to sensations from the

eye. But the physicist recognises two kinds of light, — white or mixed light, and pure or coloured light (light of one wave-length or of one vibration-rate); and we have two corresponding groups of sensations, — sensations of brightness (black, grey, white), and sensations of colour. Sound is the stimulus of hearing: but sound may be produced both by irregular, aperiodic movements of the air-particles, and by periodic movements (air-waves); and we have two corresponding types of auditory sensation, — the simple noise (irregular movement), and the simple tone (wave).

Our list will, then, take final shape as follows. To realise the part played in mind by the different groups of sensations, the reader must compare it with the corresponding list of § 22.

I. Sensations of the Special Senses (external stimulus).
  1. Visual sensations.
    a. Sensations of brightness (stimulus: mixed light).
    b. Sensations of colour (stimulus: homogeneous or pure light).
  2. Auditory sensations.
    a. Sensations of noise (stimulus: sound concussion or shock).
    b. Sensations of tone (stimulus: sound-wave).
  3. Olfactory sensations (stimulus: odorous particles carried by a draught of air).
  4. Gustatory sensations (stimulus: the chemical constitution of certain substances, which enables them to excite the organs of taste).
  5. Cutaneous sensations.
    a. Sensations of pressure and pain (stimulus: mechanical affection of cutis and epidermis).
    b. Sensations of temperature (stimulus: thermal affection of the skin).

II. Organic Sensations (internal stimulus).
  6. Muscular sensations (stimulus: contraction of muscle).

7. Tendinous sensations (stimulus: pull or strain upon tendon).
8. Articular sensations (stimulus: rubbing or jamming together of surfaces of joint).
9. Sensations from the alimentary canal.
   a. From the pharynx (stimulus: dryness of mucous membrane).
   b. From the œsophagus (stimulus: antiperistaltic reflex).
   c. From the stomach (stimulus: dryness of gastric mucous membrane).
10. Circulatory sensations (stimulus: change in circulation).
11. Respiratory sensations (stimulus: change in breathing).
12. Sexual sensations (stimulus: change in blood-supply, or in secretory activity, of the sex organs).
13. Sensation of the 'static sense' (stimulus: change in the distribution of pressure from the water of the semicircular canals of the internal ear).

References for Further Reading

Ebbinghaus, *Grundzüge*, I, §§ 6, 65–67.
James, *Principles*, I, vii.
Külpe, *Outlines*, §§ 2, 4–9.
Wundt, *Grundzüge*, I, vii, viii (§ 1).
For the sense-centres of the cerebral cortex, see P. Flechsig, *Gehirn u. Seele*, and *Ueber d. Localisation d. geistigen Vorgänge*, 1896 (*cf.* Titchener, *A Primer of Psychology*, 1899, App. ii); M. Foster, *A Text Book of Physiology*, Pt. iii, 1897, pp. 1140–1141, 1216–1221; and the physiological references given on p. 32 above.

CHAPTER III

The Quality of Sensation

I. *Sensations of Special Sense*

§ 12. **The Quality of Visual Sensations.** — The stimulus to vision is light. Physical theory regards light as a wave movement in the ether with which space is filled. Light is either mixed or pure (homogeneous): mixed, if it consists of waves of every possible length, travelling together; and pure (homogeneous), if its waves are all of the same length. Mixed light always excites the sensation of brightness; a single pure light, the sensation of some colour.

(1) *Sensations of Brightness.* — We have only five names, in ordinary conversation, to indicate different kinds or qualities of brightness: black, white, grey, dark grey and light grey. When put to a rigid test, however, the eye is found to be capable of distinguishing about 660 brightness qualities, varying from the deepest black to the most brilliant white.

The *method* by which we determine the number of brightness qualities is as follows. Four circular pieces (discs) of cardboard are prepared, two of dead black and two of white. A cut is made in each, from outer edge to centre, so that a black and a white can be fitted together, and a white sector, of any desired width, laid over the black surface. The backs of the discs are divided up into degrees and fractions of degrees, in order that the

amount of white which replaces the original black in a particular experiment may be accurately measured.

For purposes of experiment, the discs are mounted in pairs — a white behind a black — upon 'colour wheels,' which allow of their rapid rotation. When the discs are combined in this way, presenting a black and white surface, and are rapidly rotated, they give rise to a sensation of grey (§ 24). The object of the first experiment is to discover, by the comparison of an all-black disc with a surface in which there is a slight trace of white, what mixture of black and white is just different in sensation from dead black; the object of the second, to discover what amount of white must be added to black to make a grey just different in sensation from the grey of the first mixture; and so on. Each of these 'just different' brightness sensations is a conscious element.

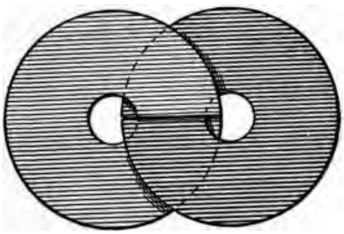

FIG. 3.—Two discs, cut for mounting upon the colour wheel. The Figure shows the way in which they are fitted together for rotation.

The sensation of brightness (black, grey, white) is produced (*a*) by the action of mixed light upon the retina or nervous network (Latin *rete*, net) of the eye. It can also be produced (*b*) by the mixture of certain pairs of pure lights, — red and verdigris, orange and greenish blue, yellow and blue, greenish yellow and violet (the 'complementary' colours); and (*c*) by the mixture, in proper proportions, of three pure lights, properly selected (red, green and violet, or red, yellow and greenish blue, etc.).

(2) *Sensations of Colour.* — The colours of the solar spectrum, which may be taken as standard or normal

colours, are named: red, orange, yellow, green, blue, indigo-blue and violet. To these may be added purple, a colour compounded of red and violet, and lying for sensation midway between these qualities. Purple is complementary to spectral green; and also produces the sensation of brightness when mixed with yellow and blue. We speak further of reddish orange, greenish blue, etc. There are thus some twenty-five words and phrases in ordinary use as names of the spectral colours.[1] But here again, the eye, when placed under experimental conditions, is found to distinguish far better than language does: we can discriminate, if the purples are included in the sum, at least 160 spectral colour qualities.

Method.—Two entirely similar spectra are thrown upon a wall, one lying directly above the other. The upper spectrum is then shut off from view by a black screen, in which a narrow upright slit is cut; nothing is seen of it, therefore, but a single line of colour,—say, of red,—coming through the slit. A similar screen, with a similar slit, is placed over the lower spectrum. The observer moves this second screen to and fro, until the line of red appearing through its slit is just different in sensation from the line of red seen through the slit of the upper screen. The lower slit is then left in place, and the upper screen moved until another just different red is obtained. The lower screen is thereupon moved again,—and so on, until the whole band of colours has been passed over; each in turn, as it shows through the slit, being compared with the next preceding colour quality. Every 'just different' colour is a conscious element.

Colour sensations, of a quite simple nature, but different from the colours of the spectral series, are produced by the

[1] Red, reddish orange, orange-red, orange, orange-yellow, yellowish orange, yellow, yellowish green, greenish yellow, green, greenish blue, bluish green, blue, indigo-blue, bluish violet, indigo-violet, violet-blue, violet, purplish violet, violet-purple, purple, purplish red, reddish purple, violet-red, reddish violet.

mixture of mixed with pure light. Thus pink results from the mixing of red and white; brown from that of black and yellow; mauve from that of purple and white. Each of the 160 spectral colours may be combined in this way with each of the 660 brightness qualities. But the more white or black we mix with a colour, the harder does it become to distinguish that colour from other colours. Hence, instead of having 160×660 colour sensations of this mixed origin, we have only about 160 × 200, or 32,000.

Method.—Two spectra are thrown on a wall, as before. The two screens are so adjusted as to show precisely the same line of colour—say, of red—in both spectra. The light from which the lower spectrum is taken is then slowly brightened, until its red line is just lighter (pinker) than the red line of the upper spectrum. Thereupon the upper line is brightened, till its red line is of a just lighter quality than the pink of the lower spectrum. The process is repeated, until one of the originally red lines is so highly illuminated that the red is lost, and only white is visible. The reverse method is then followed, each red line being darkened in turn, until one of the reds becomes black.

Every one of the 160 spectral qualities must be lightened and darkened in this way, until the full number of 'just lighter' and 'just darker' colours has been made out.

We possess, therefore, at least 660+160+32,000 qualities of visual sensation: we have to search in the structure and function of the eye for the conditions of some 32,820 conscious elements. For the qualities are all equally elemental as sensations, however different the physical processes (stimuli) with which they are connected.

Various explanations have been offered, by physiologists and psychologists, of the changes set up in the eye by the action of light. The most probable account is that given

by Professor E. Hering, professor of physiology at Leipzig. It is, in brief, as follows. There are, in the 'visual apparatus' (the eye and its central attachments), three separate 'visual substances,' three chemical compounds that are differently affected by light. Each substance is the vehicle of two chemical processes: *assimilation* and *dissimilation*, or recomposition and decomposition. The two processes are accompanied by two distinct sensations in each case. In one substance, assimilation gives black and dissimilation white; in another the sensations are green and red, and in the third, blue and yellow, respectively. The six chemical processes in the visual apparatus thus furnish us with the six *principal* visual sensations; and from these and their combinations the whole sum of visual sensations is obtained.

The three substances differ somewhat in their reaction to light. The black-white substance is affected by *every* light stimulus; the other two substances only by certain forms of stimulus. In every substance the processes of assimilation and dissimilation are antagonistic. Thus, if red and green lights fall upon the same part of the retina, the colours cancel each other, and nothing is left but a sensation of brightness (a grey). The same thing is true of yellow and blue.

It must be carefully noted that Hering's 'principal' psychological colours do not always correspond to the 'pure' colours of the spectrum. Hering's 'red' is a red which lies outside the spectrum altogether, towards the purple; and his 'green' is a slightly bluish green. Pure spectral 'red' is psychologically an orange-red. We cannot argue directly out of physics into psychology; though the general correlation is as given on p. 50.

An apparent objection to Hering's theory is this. If black and white fall upon the same part of the retina, we see a *mixture* of

black and white, a grey; there seems to be no cancellation of black by white, as there is of green by red, etc. It has recently been shown, however, by Professor G. E. Müller, Lotze's successor at Göttingen, that black and white really do cancel each other in the retina; there is no grey process there. But the *cortical* cells with which the retina is connected are always in a state of excitation (owing to changes of temperature), whether there is a stimulus acting on the eye or not; and this excitation gives us the 'intrinsic' or 'subjective' visual sensation, the sensation of grey.

The various sets of three pure lights (red, green and violet; red, yellow and greenish blue; orange, green and violet; purple, — we have admitted purple to the rank of a spectral colour, — yellowish green and bluish green, etc.) which, when mixed in certain proportions, arouse the sensation of brightness, will, if mixed in certain other proportions, arouse that of colour: and it is possible, by varying the proportions, to get from each set of three all the different colour qualities. But red, green and violet give far richer and more brilliant colours, when rightly combined, than do any other three qualities. Hence these are known as the *primary* colours of the spectrum.

The four principal colours, — green, blue (§ 5), red, yellow, — are, as might have been expected from their psychological importance, of especial interest in practical life. Red is the colour of blood (Skt. *rudhira*, Icel. *rothra*, blood); yellow is the pale colour of young vegetation (Gk. χλόη, χλωρός), and thus has the same significance, derivatively, as green. The four colours are no *simpler*, as conscious processes, than the other colour qualities.

The word 'mixture' in this Section means always mixture of lights, and not of pigments (paints). Mixture of blue and yellow light gives a sensation of grey; mixture of blue and yellow paints gives a sensation of green. The blue pigment crystals reflect blue and green light, the yellow crystals, yellow and green light. The blue and yellow cancel each other, and only a green is left to be seen.

§ 13. **The Quality of Auditory Sensations.** — The stimulus to hearing is sound. From the physical point of view

sound is a movement of the air particles. The movement may be continued and regular (sound-wave) or momentary and irregular (shock or concussion); or it may consist of mixtures of waves and shocks, or of successions of shocks. A sound-wave excites the sensation of tone; a mere concussion, or a wave movement of less than two complete undulations, the sensation of simple noise. The other forms of air movement are connected with complex auditory processes.

What we commonly call the 'pitch' or 'height' of tones is their psychological 'quality.' Differences in the quality of simple noises may also be conveniently expressed by these terms, although they are ordinarily employed only with reference to tone.

(1) *Sensations of Tone.* — We speak of tones as 'high' and 'low,' 'harsh' and 'clear,' 'shrill' and 'mellow'; and we distinguish 'thin' tones from tones which possess 'volume,' etc. We also have symbolic names for the twelve tones comprised within each of the seven octaves of the musical scale: $C\natural$, $E\sharp$, $b\flat$, $d^2\sharp$, $a^5\natural$, etc. When accurately tested, however, the ear is found to be master of a much wider range of tones than language indicates; we can hear about 11,050 different tones.

Method. — One of two precisely similar tuning-forks has its tone lowered or 'flatted' a little by the attachment of a small weight to one of its prongs. The forks are struck, one after the other, at an interval of a few seconds, and the listener is required to say whether their tones seem to him alike or different. The flatting is increased, until he finds the tones just different. Then the weighted fork is taken as standard, and the other weighted a little more heavily, — until its tone appears just different from (flatter than) the slightly lowered tone of the first experiment. The tests are repeated upon a large number of forks of different natural

pitch, so that no tone quality which can possibly be sensed is missed. It will be found in this way that tone sensations furnish the 11,050 conscious elements mentioned above.

(2) *Sensations of Simple Noise.* — Language has several words to express different kinds of simple noises: snap, rap, tap, puff, pop, shock, crack, flick, thud, etc. We also use various adjectives to indicate various noise qualities: 'sharp' crack, 'dull' thud, etc. As usual, however, the sense-organ can draw finer distinctions than are drawn by language: we can discriminate some 550 qualities of simple noise.

Method. — If a tuning-fork is struck, and more than two of the air-waves which its vibration occasions are allowed to reach the ear, we hear a tone. If less than two complete undulations are heard, — the rest being cut off from the sense-organ by the dropping of a sound-proof screen between it and the fork, — we get a sensation not of tone but of simple noise.

Two forks are taken, as in the previous experiment. Let us suppose that one vibrates 128 times in the 1 sec., and the other (the flatted fork) 126 times. The former is sounded for something less than $\frac{2}{128}$ sec., and the latter for something less than $\frac{2}{126}$ sec.; and the observer notes whether the two noises are of like or different quality (height or pitch). If they are alike, the experimenter flats the flatted fork still further, until the observer remarks a difference in noise quality. A record is then made; and the experiment proceeds as in the case of tones.

Most of the noises which we are accustomed to hear (crash, roar, hiss, rattle, splash, clatter, etc.) are of a complex nature, comprising several simple noises or a number of these mixed with tones.

Sound is received into the outer passage of the ear, conveyed inwards by a series of vibrating bodies (elastic membrane, chain of small bones, etc.), and finally produces

a movement in the water (endolymph) of the cochlea of the internal ear. The cochlea is a hollow tube, through the whole length of which is stretched a membrane, the basilar membrane. The cross-fibres of this membrane are arranged like the strings upon the backboard of a piano; they are very short at the beginning (treble strings) and gradually increase in length as the membrane continues (bass strings). Each cross-fibre carries sensitive cells, with which the fibrils of the auditory nerve are connected. A movement of the water in the tube excites the cells standing upon particular strings or cross-fibres. Only those strings are affected, in a given case, whose vibrations correspond to the sound outside the ear which causes the movement of the water. Every string may thus be said to be 'tuned' to a certain sound-wave.

We may illustrate this process by supposing that the top of an upright piano is turned back, and a word shouted into the body of the instrument. The piano is 'set ringing'; certain strings are thrown into vibration, because the speaking voice contained certain tones to which those strings are 'tuned.' Different strings respond, according as the word is pitched high or low.

The sensation of tone arises when a fibre of the basilar membrane is made to vibrate regularly by more than two successive wave movements of the endolymph; that of noise, when a fibre gives a jerk or twitch, in answer to a single push or less than two complete wave movements of the endolymph. Physically, therefore, a simple noise is merely an imperfect tone. There is no sharp line of division between the stimuli: two complete wave movements will give rise now to one and now to the other sensation. The sensations themselves are, however, quite distinct.

§ 14. **The Quality of Olfactory Sensations.** — Smells are ordinarily classified as agreeable and disagreeable, and named after the objects which give rise to them (musk, violet, etc.) without regard to their likeness or unlikeness in sensation. It is impossible, in the present state of our knowledge, to say how many qualities of smell the nose can distinguish. In all probability the number is very large. It is also probable that smells fall into groups of similar qualities, and that the members of each group form graded series, like those of tone or brightness.

Method. — Prepare a number of solutions of odoriferous substances. Close one nostril with cotton-wool, and sniff at a solution until you can smell it no longer. This will soon happen, as the nose is easily fatigued. Then sniff at another. If this is smelled, its quality differs from that of the first solution; if you cannot smell it, its scent is the same as the scent for which the nose has been fatigued. If you exhaust the sense of smell by tincture of iodine, you will find that you can still smell oil of lavender, but that you cannot smell alcohol at all. If you fatigue the nose with ammonium sulphide, you will still be able to smell oil of anise, oil of turpentine, oil of lemon and eau de Cologne; but you will be unable to smell sulphuretted hydrogen, hydrochloric acid (7 parts of concentrated solution to 50 of water) and bromine ($\frac{1}{10}\%$ solution). These facts mean that the quality or complex of qualities in tincture of iodine is entirely different from that of oil of lavender, but contains or is contained in the alcohol quality or qualities. And so with the ammonium sulphide.

The method assumes that the sensitive cells, set in the mucous membrane of the nose, respond some to one quality of scent and some to another, so that when one cell-group is exhausted, others are still fresh. The assumption seems to be justified by the results of experiments upon taste (§ 15): the organs of the two senses are very similar.

Substantives like 'scent,' 'odour,' 'perfume,' 'bouquet,' and adjectives like 'aromatic,' 'fragrant,' 'redolent,' 'savoury,' are

either quite general terms (corresponding to 'bright,' 'colour,' 'flavour,' in other sense departments) or refer to objects grouped together for practical purposes (cookery, the toilet, etc.). They do not help us towards a psychological classification of smell qualities.

§ 15. **The Quality of Gustatory Sensations.** — There are four qualities of taste: sweet, bitter, acid and salt. All the other 'tastes' of which we speak in everyday life are complex perceptions.

Thus the 'taste' of lemonade is made up of a sweet taste, an acid taste, a scent (the fragrance of lemon), a sensation of temperature and a pricking (cutaneous) sensation. The 'taste' of lime-water is made up of a weakly sweet taste, a sensation of nausea (organic sensation), a sensation of temperature and a biting (cutaneous) sensation. The 'taste' of tea is made up of a bitter taste, a scent, a temperature sensation and an astringent (cutaneous) sensation. 'Tea tasters' and 'wine tasters' should rather be called 'tea' and 'wine smellers.'

Sensations of brightness, colour, noise, tone and (probably) smell form unbroken *series* of qualities. We can pass gradually from black to white, through intermediate shades of grey; we can pass from bass to treble, without any break or interruption of the scale, etc. The sensations of taste, on the contrary, do not constitute a series; 'sweet' is not in any way nearer or more like 'acid' than it is like 'salt.' Each of the four qualities stands out distinctly by itself, so that if we did not know that all four came from the tongue, we might be disposed to think that they belonged to separate senses.

Tastes, however, resemble visual sensations in the fact that they *contrast* with one another. A red seen upon a grey background tinges the neighbouring grey with ver-

digris; and a grey seen through a black tube looks whiter than otherwise would be the case. So an acid seems more sour after a sweet; and salt and sweet, if applied at the same time to different parts of the tongue, are salter and sweeter than they would be if sensed singly.

Method.—Seat yourself before a concave (enlarging) mirror, and put your tongue out. You will notice that the pink skin of the tip is dotted with redder, darker, and more transparent-looking flecks. These are the *papillæ fungiformes*, little folds of mucous membrane, in which are planted the sensitive cells forming the organs of the nerve of taste. Dip fine camel's-hair brushes into the solutions which you wish to test, and apply them carefully to single papillæ. The tongue must be dried to prevent the solution from 'running'; and the nose closed, to prevent any interference of smell with taste proper. You will find that the only sensations obtainable are those of sweet, bitter, acid, and (weakly) salt.

To test *contrast*, fill the mouth with a sour solution; then spit this out, and fill with a sweet liquid: or brush sweet on one side of the tip of the tongue, and salt on the other. To prove the absence of simultaneous contrast in the domain of smell, place tubes containing different scents in the two nostrils, and sniff. You will either have a single smell throughout the experiment; or the two smells will be sensed alternately, neither affecting the other. There is, however, good evidence of successive smell contrast. Tones and noises do not contrast with one another when simultaneously heard; and probably do not, when heard successively. Musical contrast is affective (§ 56), not sensible.

§ 16. **The Quality of Cutaneous Sensations.**—The skin can be stimulated both mechanically (by pressure, a blow, tickling, etc.) and thermally (by the application to it of hot and cold objects).

(1) *Sensations connected with Mechanical Stimulation.*—In the spheres of sight, hearing and smell there are far more sensation qualities than there are names to indicate them.

On the other hand, language is rich in names for 'tastes'; but these names indicate, not simple sensation qualities, but mental processes which are really of a complex nature, and arise from the excitation of two or more senses. The mechanical cutaneous sense resembles that of taste in this respect. We are apt to speak of 'sensations' of touch, resistance, impact, tickling, etc., and to think of them as coming to us exclusively through the skin. In reality, these processes are all mixtures of cutaneous and organic sensations. There are only two qualities of the mechanical cutaneous sense: the qualities of *pressure* and *pain*.

(1) *Contact* is simply a very light pressure: there is no difference of quality between the two experiences. (2) *Hardness* and *Softness* are primarily differences of the intensity of pressure. Often, too, they contain certain of the organic qualities connected with bodily movement, and sometimes qualities of temperature (a 'soft' is either a 'clammy' or a 'warm soft'). (3) *Sharpness* and *Bluntness* are primarily differences of the extent of pressure. Sharpness often contains in it the further quality of pain. (4) *Roughness* and *Smoothness* differ as interrupted and continuous extent of pressure. A full appreciation of either requires movement over the rough or smooth surface: if a rough or smooth object be pressed down upon the passive skin, no difference is sensed until the pressure becomes quite intensive. Then the observer realises that he has in the one case a continuous sensation of uniform intensity (smooth), and in the other a number of severe separate pressures, with or without light pressure over the intervening spaces (rough). (5) *Wetness* and *Dryness* are easily confused, if the conditions of the test allow the skin to remain passive. They are likely to differ in temperature: but we ordinarily distinguish them by the different resistance which they offer to the moving hand. (6) *Resistance* is a complex perception, containing organic sensations from muscle, sinew and joint, in various proportions, as well as the cutaneous quality of pressure.

(7) *Touch* is active pressure, *i.e.*, pressure *plus* the organic sensations arising from movement. (8) *Impact*, if the stimulus is weak, is a sudden pressure, possibly mixed with the organic sensation of tickling. If the stimulus is strong, other organic sensations make their appearance in the perception. In either case, an emotion (surprise) is usually present. — It is clear that these terms are neither all mutually exclusive, nor all sharply defined.

Many of the complexes, resolved here into cutaneous and organic qualities, also contain, under ordinary circumstances, a visual quality, remembered or imagined. Thus the differentiation of pressure and contact depends not infrequently on the fact that when we are pressed with any degree of force we can imagine what the object is which presses us, whereas contact (very light pressure) carries with it no visual idea of its stimulus.

So far, then, analysis justifies our statement that there are only two qualities of the mechanical cutaneous sense.

Method. — Go over a portion of the skin, dot by dot, with a pointed pencil of cork or pith. If you press lightly, you will find that there are certain spots from which you get a sharp, well-defined pressure sensation, while the intervening spaces are insensitive. If you press harder, you will receive more intensive pressure sensations from the 'pressure-spots,' and a dull, diffused pressure sensation from the intervening spaces, which were insensitive to less severe stimulation. — The 'pressure-spots' occur where a sensory nerve-fibril terminates in the *cutis;* where there are no nerves, the skin is insensitive. The nerve-endings either twine round the root of a hair, or form a sort of skein or tangle just below the *epidermis.* The dull sensation arising from intensive pressure upon insensitive areas is due to the spread of stimulation from the point pressed to neighbouring 'pressure-spots.' There is no difference in quality between the dull and sharp pressure sensations, or between those derived from the different nerve-endings. — For the quality of *pain*, *cf.* § 21.

(2) *Sensations connected with Thermal Stimulation.* — Language and scientific observation are here in agreement. Both alike recognise two qualities of the thermal cuta-

neous sense: warmth and cold. We may lay it down as a general rule that any stimulus whose temperature is above 34° C. (the average natural temperature of the healthy skin) gives rise to a sensation of warmth, and that all stimuli below that temperature give rise to sensations of cold.

Method. — Take a hollow metal tube, brought to a sharp point at its lower end. Fill it with hot or cold water, and pass it lightly and evenly over a portion of the skin. Move slowly, but be careful not to fatigue the sense-organ. You will find that cold sensations, of very definite extent, flash out in response to the cold stimulus; while the hot point reveals definite spots or areas of the skin which are sensitive to warmth. The intervening spaces are insensitive to temperature.

The 'warm' and 'cold' spots of the skin, like the pressure-spots, occur only where a sensory nerve-fibril terminates in the *cutis*. The mode of termination differs for the two kinds of temperature-spots, and is in each case different from that of a pressure-spot. It is noteworthy that a cold-spot (which is naturally irresponsive to a hot stimulus) replies by a 'paradoxical' sensation of cold to stimuli of 48° C. and over; and that the simultaneous stimulation of a warm and a cold spot by these temperatures produces a new sensation quality, — the sensation of 'heat.'

The 'internal skin' of the body, or mucous membrane, appears to be sensitive to pressure throughout most, if not all, of its extent, but to be insensitive to temperature from the pharynx downwards. A sudden draught of cold water is, undoubtedly, sensed internally: but accurate introspection localises the cold sensation not in the stomach, but in the body-wall. That is, the nerve-endings affected are the same as those which are reached by external cold-stimuli.

The investigation of the temperature sense is exceedingly difficult, since the skin adapts itself readily to wide differences of outside temperature. Place the two hands in two bowls of cold water. Gradually heat the water in which the right hand is laid, and cool that in which you have put the left. You can alter the

temperature of the two waters very considerably, and the two hands will still 'feel comfortable.' But now take the left hand out of the cooled water, and dip it into the bowl of heated water: the heat will seem so great as to be painful to it, though the right hand still experiences only an agreeable warmth. The two hands have become adapted to different temperatures.

II. *Organic Sensations*

§ 17. **The Quality of Muscular, Tendinous and Articular Sensations.** — In the preceding Sections of this chapter, in which we have been dealing with the sensations of the special senses, we have taken it for granted that a single quality (red, hot, sweet) can be sensed by itself, independently of all other qualities. This is not strictly true; for consciousness is always complex, always consists of more than one process (§ 43). But it is approximately true. We can attend so strongly to one simple impression that the sensations set up by other stimuli, active at the same time, are for all practical purposes non-existent; and we can, further, arrange the external conditions of our observation in such a way as to bring the particular quality into unusual prominence.

In the sphere of organic sensation, on the other hand, it is very difficult to detach any single sensation from those which ordinarily accompany it. The simple qualities are here so closely woven together that the psychologist does not even know what to look for when he begins his analysis. And the sense-organs within the body are not separated as are those upon its surface: muscle and tendon, *e.g.*, pass directly into each other. Nevertheless, careful experiments made during the last few years upon the normal individual, and careful observations of pathological cases (anæsthesia or insensitiveness of particular internal

organs), have thrown some light upon the nature of the elementary processes included under the general title of organic sensations.

(1) *Muscular Sensation.* — The 'voluntary' (striped) muscles of the body are supplied with sensory nerves. The fibrils of these nerves terminate among the muscle fibres just as the cutaneous nerve-fibrils terminate beneath a pressure-spot. Muscular contraction occasions a specific sensation, the quality of which somewhat resembles the quality of cutaneous pressure. Under ordinary circumstances, this quality is too weak to be separately sensed.

Method. — Lay the arm comfortably upon a table or arm-rest, and keep it steady. Render a portion of the skin anæsthetic, by cocaine injection, ether spray, etc. Now press hard upon the skin, so as to flatten the underlying muscle; or stimulate the muscle electrically by a strong induction current, so that it contracts. You will have a faint, dull sensation, the seat of which appears to be the muscle.

When you are aroused from a dream by fright, you will notice a pressure in the region of the heart. This pressure is due to an abnormal excitability (hyperæsthesia) of the sensory nerves which terminate in the cardiac muscle.

Slight muscular fatigue also brings out the specific pressure quality of the muscular sensation. Excessive contraction appears to produce the sensation of *pain*: *cf.* § 21.

(2) *Tendinous Sensation.* — Like the muscles to which they are attached, the tendons are supplied with sensory nerves. The nerve-endings in tendon, however, are different in form from those in muscle or skin. The specific quality of tendinous sensation is not the quality of pressure, but that of tension or strain.

Method. — Lay your arm and hand, palm upwards, upon a table. Place a small ball, or other round object, in the palm,

and close the fingers lightly round it. Note carefully the sensations which you are receiving from hand and arm. Now grasp the ball as tightly with the fingers as you can. You obtain, almost immediately, a new sensation, that of strain. This sensation quality is different from any skin sensation (pressure, warmth, cold) and from the muscular sensation observed in the preceding experiment.

The new quality might, however, proceed from the joints, since in curling your fingers over the ball you have altered the mutual pressure of various articular surfaces. You may easily assure yourself that it does not. Let your arm hang down loosely by your side. Attach a fairly heavy weight by a string to the forefinger. The weight pulls the surfaces of the elbow and other joints apart; so that there is no pressure or friction of one surface against another. But you soon get the sensation of strain throughout the arm.

If the sensation of strain is different from any sensation obtainable from skin or muscle, and is independent of stimulation of the joints, it must come from the tendons.

(3) *Articular Sensation.*—The surfaces of the joints are richly supplied with sensory nerves, whose endings resemble certain of those found in the skin. The quality of articular sensation, like that of muscular, may be described as a pressure. But the articular sensation is far more important than the muscular, since (as we shall see later, § 46) it is one of the two principal sources from which we obtain knowledge of the position or movement of the limbs.

Method.—Tie a moderately heavy weight by a string to the forefinger of the right hand. Lay a soft cushion on the floor, so that the striking of the weight upon it will not be heard. Close the eyes and lower the hand quickly, till the weight rests upon the cushion. At the moment of striking, you experience a push upward, as if the string had become rigid and were thrust against you. The push is localised within the arm. It is due to the

spring back of the lower against the upper articular surfaces, which takes place when the limb is released from the pull of the weight. It can only be described as a pressure sensation.

§ 18. **The Quality of the Alimentary Sensations.** — Here we seem to find at least three new qualities: those of hunger, thirst and nausea. Each of these experiences is complex; but each appears to contain, in addition to sensations of pressure and temperature, a specific quality.

(1) Hunger is localised in the stomach. When the stomach has digested a mass of food, its walls begin to dry, and fall into folds or ridges. The dryness and folding somehow stimulate the nerve-endings in the mucous membrane of the stomach. There then arises the organic sensation of hunger. (2) Thirst is localised in the mouth and pharnyx. A dryness of the mucous membrane in this region somehow stimulates the nerve-endings. We do not know precisely in what way the thirst sensation is set up. It can be removed by painting the back of the mouth with a weak solution of citric acid. (3) The specific quality of nausea seems to be due to the pressure upon the nerve-endings in the œsophagus which occurs during the first stages of the vomiting reflex. It may be that this quality is that of pressure (*cf.* joint and muscle). Nausea usually contains sensations of taste, smell and giddiness; and its components are so intimately blended that analysis is exceedingly difficult.

§ 19. **The Quality of the Circulatory, Respiratory and Sexual Sensations.** —(1) Tickling, itching, tingling, pins and needles, feverishness, etc., are not simple sensation qualities, but complexes, made up of sensations of cutaneous pressure, sensations of temperature, and organic sensations called forth by alteration in the circulation of the blood. It is doubtful whether these organic sensations are novel qualities. (2) The action of the lungs, like that of the heart, does not normally excite sensation. But in the complex perceptions of freshness and closeness of the atmosphere, of

breathlessness, of a 'bracing' air, in the 'feeling' of suffocation, etc., the stimulation of nerve-endings within the lungs themselves apparently arouses a true respiratory sensation. (3) The sex organs furnish a specific sensation quality. They are also sensitive to pressure and temperature.

Tickling can be produced by moving a pencil, lightly or intermittently, over the palm of the hand; tingling by keeping the legs crossed at the knee until the upper one 'goes to sleep,' and then uncrossing. It is noteworthy that tingling can also be occasioned by a jar upon a nerve trunk, as is shown by the effect of a blow upon the elbow ('funny bone').

§ 20. **The Quality of the Static Sense.** — The internal ear consists of the cochlea (§ 13), the vestibule and the semicircular canals. The vestibule is a membranous bag filled with endolymph. The canals — also composed of membrane, and filled with endolymph — are three semicircular tubes, arranged in the three planes of space.

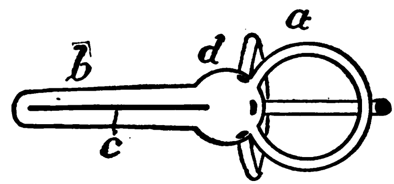

FIG. 4. — Diagram (schematic) of the internal ear, in longitudinal section. *a*, semicircular canals; *b*, cochlea; *c*, basilar membrane; *d*, vestibule.

All three structures are continuous; but the two last constitute a special organ, distinct in function from the cochlea. They possess a special nerve, whose fibrils terminate in hair-cells, planted in the walls of the vestibule and at the bases of the canals.

There is good evidence for the hypothesis that the canals and vestibule constitute an apparatus which assists us to maintain our equilibrium and to estimate correctly our position in space. As we move our head or body in

different directions, the endolymph washes against different groups of hair-cells, and the nerve-fibrils are thus stimulated. Ordinarily, the action of the apparatus is not attended by sensation (*cf.* heart and lungs); but if equilibrium is seriously disturbed, or our position in space abnormal, we receive from the vestibular nerve-endings the organic sensation of giddiness.[1]

Method. — Twirl round quickly upon your heels for a few seconds. When you stop, your equilibrium is uncertain, you stagger; and at the same time you 'feel dizzy.' A sudden sharp jerk of the head towards one side, or up or down, produces a momentary dizziness. Or place yourself in an abnormal position, upon your head, upon a narrow plank over a deep ravine, etc. Again you have the organic sensation of giddiness.

The evidence for the view that giddiness proceeds from the internal ear is derived from three sources. (1) Psychological experiments have been made by the aid of the 'tilt-board' and 'rotation table.' These are beds or tables, upon which the subject is laid at full length. The tilt-board can be slanted, see-saw fashion, in either direction, so that the subject's head or feet may be raised or lowered through any angle. The rotation table can be revolved, at any angle of inclination. The subject is tilted, or rotated, with eyes shut; and, this done, is required to open his eyes and judge of the position of certain objects shown in the field of vision. The results of such experiments point to the existence of a special mechanism, situated in the head, which subserves equilibration, etc. (2) Pathological observation helps us to determine what this organ is, and to bring it into connection with the sensation of giddiness. If patients with damaged vestibule and canals are twirled upon the rotation table or in a rotating chair, they neither become giddy, nor make any allowance for centrifugal force, as the normal subject does. (3) Vivisection confirms pathology. An animal whose canals have been cut cannot maintain its equilibrium.

It might be thought that as all three parts of the internal ear are

[1] For another possible quality of the static sense *cf.* § 48.

continuous in structure, and as the mode of excitation of nerve-endings in vestibule and canals is the same as that in the cochlea, — in all cases it is the impact of water upon the hairs of sensitive cells, — the static sense should be numbered, with audition, among the special senses. But although the mode of excitation is the same, the cochlear stimulus — an air-wave — is externally originated, while the stimulus to giddiness is internal, a change in the organ itself.

§ 21. **Pain.** — Pain seems to be, like pressure, both a specific (cutaneous) and an organic sensation quality. It is set up both by injury to the epidermis and by excessive muscular contraction. The concrete pain excited by a dazzling light or a cut of a finger contains three distinct factors: a sensation of special sense (light or cutaneous pressure), the sensation of pain, and a severe unpleasantness (§ 31). In extreme pain the first of these factors is far outweighed by the other two. But we always know that it is the finger which is cut, a tooth that is aching, etc.; and this knowledge of locality comes from a sensation of special sense or specific organic quality contained, besides pain proper, in the complex experience.

The mechanism of the muscular pains (pains of eye-muscles, from blinding light; of ear-muscles, from shrill sounds, etc.) is not yet fully understood. The *epidermis*, the rigid covering of the elastic *cutis*, contains free nerve-endings. Moderate mechanical stimulation leaves these unaffected, passing through at once to the *cutis;* when the *epidermis* is cut or bruised, however, its nerves respond by way of pain.

All the sensations and sensation-complexes described above under the heading of organic sensations, together with certain of the sensations of special sense (temperature, *e.g.*) were formerly called 'common' sensations. It was believed that they could be occasioned by the stimulation of any, or at least of more than one, group of sensory nerves. They were looked upon, that is, as 'common' to several widely different sense departments.

Until quite recently, there was good reason for thinking that *pain* was a common sensation in the strictest sense of the term: a sensation producible by excessive stimulation of *any* sensory nerve (optic, cutaneous, etc.). It is now certain that pain is derived only from skin and mucous membrane, striped muscle, joint, and (possibly) bone-tissue. Pressure, therefore, is as nearly a common sensation as pain: it, too, can be set up by stimulation of nerve-endings in skin and mucous membrane, in striped muscle and in joint. We may regard pressure and pain as the most primitive sensations of the organism, the first to appear in the course of mental evolution. — There are many other names for complexes of organic sensations, besides those noticed in the text. But there are no other specific sensation qualities. Fatigue, drowsiness, health, discomfort, etc., can easily be resolved (so far as they consist of sensations: § 32) into factors already mentioned.

Method.— It is difficult to assure oneself of the qualitative similarity of the specific (cutaneous) and organic (muscular) pains, because the presence of pain is extremely unfavourable to introspection. But the following method may be successfully employed. Press a blunt rod down upon your chest, until the pressure becomes painful, and let an assistant, when you give the word, sound a painfully shrill tone upon a piston whistle. After a few trials you will be able to introspect well enough to convince yourself that the two pains have the same quality.

§ 22. **The Total Number of Elementary Sensations.** — Putting together the results of the foregoing Sections, we obtain the following list of sensation qualities:

Eye	32,820	Alimentary canal .	3?
Ear (audition) . .	11,600	Blood-vessels . .	?
Nose	?	Lungs	1?
Tongue	4	Sex organs	1
Skin	4	Ear (static sense) .	1
Muscle	2		
Tendon	1	More than	44,435
Joint	1		

Each one of these forty thousand qualities is a *conscious element*, distinct from all the rest, and altogether simple and unanalysable. Each one may be blended or connected with others in various ways, to form *perceptions* and *ideas*. A large part of psychology is taken up with the determination of the laws and conditions which govern the formation of these sensation complexes.

The above list represents the full resources of the normal mind. It must not be supposed, however, that every normal individual has had experience of all the qualities enumerated. It is safe to say that no one, not even the most experienced psychologist, has seen all the possible visual qualities, heard all the possible tones, smelled all the possible scents, etc. The list is a summary of the results obtained by many observers in the course of minute investigations of our capacity of discrimination in the various fields of sense.

Apart from this, a slight abnormality is much more common than is ordinarily supposed. Very many people are more or less colour-blind; they confuse red with green, or have a shortened spectrum, *i.e.*, do not see the full number of red and violet qualities. Very many are partially tone-deaf, have a defective sense of smell, etc. But when all allowances are made, the average number of conscious elements must run into the tens of thousands.

References for Further Reading

Ebbinghaus, *Grundzüge*, I, §§ 13-36.
Külpe, *Outlines*, §§ 10-23, 49, 50, 68.
James, *Principles*, II, xvii.
Wundt, *Grundzüge*, I, ix.
Consult also: E. Mach, *Contributions to the Analysis of Sensations*, 1897.
For Müller's theory of vision, see articles in *Zeitschrift f. Psychol. u. Physiol. d. Sinnesorgane*, 1896-1897; for the Helmholtz theory of audition, see the *Sensations of Tone* (1895), pp. 145 ff., and V. Hensen, in Hermann's *Handbuch d. Physiol.*, III, 2, *Physiol. d. Gehörs*, ch. ii; for pressure and pain, M. von Frey, *Druckempfindung u. Schmerz*, 1896; for temperature and articular sensation, A. Goldscheider, *Gesammelte Abhandlungen*, I, II, 1898.
For experiments, see E. B. Titchener, *Experimental Psychology*, i, 1, 2, 1901.

CHAPTER IV

THE INTENSITY, EXTENT AND DURATION OF SENSATION

§ 23. **Intensity, Extent and Duration as Attributes of Sensation.** — Every sensation quality possesses a certain strength or *intensity*, and lasts for a certain *length of time*. The qualities of colour, brightness, and cutaneous and articular pressure have always, in addition to duration and intensity, a certain *extent*, *i.e.*, are spread over a certain amount of space within the field of vision or of touch.

It is evident that sensations may differ very widely in all three respects. We can hear the faint sound made by the fall of a pin upon the floor, and we can hear the roar of thunder (intensity); we can see as long as daylight lasts, and we can see a momentary flash in the dark (duration); we can appreciate the pressure of a needle-point, or that of the water in which the whole body is immersed (extent). Not only, then, can each of the forty thousand sensation qualities combine with other qualities, to form a perception or an idea, but each quality can combine at various intensities, for different lengths of time, and, in the four cases mentioned, in varying extent.

In § 7 we analysed the idea of a book into sensations of sight, sound, smell, pressure and strain. These qualities are present in the idea of every book. But the smell of the leather binding may be faint or strong; the pressure of the volume on the hand may

be light or heavy; the strain of holding it great or small. The component sensations, *i.e.*, may differ widely in intensity. Again: the scent, pressure and strain are less important elements of the total idea than are the qualities of sight. When we 'think of' the book, we shall probably recall both smell and weight; but they will not long remain as constituents of our idea. After a few seconds, perhaps, they will have entirely disappeared, and the idea of the book will be an exclusively visual idea. The visual elements persist as long as we continue to think of the book. The component sensations, then, differ widely in duration. Lastly: the yellow of the gold lettering and the red of the leather cover are both sensation qualities contained in the idea; but there is a greater extent of red than of yellow.

It is clear, then, that a few qualities may give rise to a large number of different ideas, in consequence of differences in intensity, duration and extent. My ideas of two books may be very different, although the qualities of sensation which they contain are the same.

Three questions might be asked in connection with these three attributes of sensation. We might enquire: (1) What are the least intensity, extent and duration which a sensation may possess and still be a sensation? (2) What are the greatest intensity, extent and duration which a sensation quality can reach? And (3), just as we asked how many qualities of sensation could be ascribed to the eye, the ear, the skin, etc., so we might now ask: How many different intensities of sensation lie between the faint sound that we can barely hear and the loud sound that is almost loud enough to stun us? How many different sizes of black or red can we distinguish, from the tiny dot which is just visible, up to the expanse which fills the whole field of vision? How many durations of temperature sensation can we obtain, from the heat which flashes in consciousness for an instant, and then dis-

appears, to that which persists so long that it ceases to be itself and is lost in pain?

The first of these questions we can answer, at least in a large number of cases. The second we cannot answer with the same degree of certainty. Our answer to the last plainly depends upon our answer to the other two. We cannot say, *e.g.*, how many different intensities lie between the two extremes of sensation — the weakest and the strongest — unless we know what these two extremes are. As we cannot determine the upper extreme very certainly and our knowledge of it cannot therefore be very accurate, we cannot calculate the whole number of sensation intensities, and compare it with our list of sensation qualities. Fortunately, the third question may be left unanswered, as regards all the three attributes under discussion, without any loss to psychology. We shall see later (§ 26) that the attempt to answer the first two suggests another, which takes the place of our present third question, and which can be satisfactorily and profitably answered.

§ 24. **The Minimal Intensity, Extent and Duration of Sensation.** — (1) It is a familiar fact that in every department of sensation there are stimuli which are too weak to be sensed. We know that the clock of the church tower is ticking, because we see that its hands move: but the noise of the ticking is too faint to be heard from the ground. As we climb the stairs, it becomes audible.

What we have to do, in order to discover the point at which sensation begins, is to take a stimulus which is too weak to be sensed, and gradually increase it until it calls forth a sensation.

Method. — Methods of determining the least noticeable intensity of stimulus follow the same general principle in all sense

departments. It will only be necessary, therefore, to give two or three concrete illustrations.

To find the least noticeable intensity of *noise.* — Let the subject be seated, with closed eyes, in a large room which has no echo. Hold a watch before his face, and gradually remove it from him — taking care to hold it always directly fronting him, and to keep it at the right height above the floor (*i.e.*, on a level with the ear) — until he ceases to hear its ticking. Measure the distance from this spot to the centre of an imaginary line joining his two ears. The distance will be somewhat too short: the sound has been growing fainter throughout the experiment, and he has therefore been expecting it to disappear. He has not been altogether impartial (§ 10). Now start again from a point some few feet beyond the spot at which sensation ceased, and move the watch slowly towards the subject, till he can hear the ticking. This point will probably lie on the far side of the other, as he knows that the ticking will soon be heard, and is therefore expecting it. Measure as before. Take the average of the first (too short) and second (too long) distances. The least noticeable intensity of noise is the intensity of the tick of the watch at this average distance.

The investigation of the intensity of *visual* sensations is peculiarly difficult. For (*a*), as we have seen (p. 57), the visual centre in the brain cortex is never free from excitation. When we close our eyes, or enter a room from which light is shut out, we still *see;* we see a grey, and grey is one of the brightness qualities. This 'intrinsic' brightness sensation, therefore, is always mixed with the brightness of the stimulus which we employ to test the eye. (*b*) We cannot change the intensity of a visual sensation without at the same time changing its quality. If we make a grey lighter, it becomes a different grey, *i.e.*, another sensation. In all the other sense departments it is possible to vary intensity independently of quality.

All that we can do, then, is to enquire what amount of light is necessary to give a sensation of brightness just different from (brighter or stronger than) the 'intrinsic' grey of which we have spoken. For the purpose of this enquiry, the subject is placed in a dark chamber; and, when his eyes have grown thoroughly

accustomed to the dark, a metal wire is heated until it just 'shimmers.' The intensity of the just noticeable shimmer must be measured by the aid of a 'photometer,' such as is employed in physical laboratories.

It is also by no means easy to ascertain the least noticeable intensity of *temperature* sensations. The skin has a natural warmth, as the eye has an intrinsic grey; and this warmth — which differs considerably from time to time — is added to or subtracted from the temperature of the stimulus, according as it is hot or cold. The part of the skin under investigation — say, the hand — must be kept in water of a neutral temperature, until the cutaneous organs have become adapted to it. The hand is then plunged into water which is slightly warmer or colder than this, and the point noted at which an increase or decrease of temperature is sensed.

(2) A stimulus may be too small to be sensed. We know that there is a skylark somewhere above us, because we saw it rise from the grass, and can still hear it sing: but it is too small to be seen. There is, then, a certain minimal extent of visual stimuli, by which no sensation is aroused. And what holds of sight, holds also of cutaneous and articular pressure.

Method. — To find the least noticeable extent of *brightness.* — Two white threads are stretched vertically over a grey background, at a convenient distance from the eye. They are very slowly and gradually brought together, until they seem just to touch. This will happen when they are actually separated by some little distance. The procedure is now reversed: the threads are gradually separated, until they seem to the eye to be just apart. The average of the two distances between them (the first too large, because their junction was expected; the second too small, because their disjunction was expected) is the least noticeable extent of grey, in the horizontal direction, at the given distance from the eye. It corresponds to a distance of about .005 mm. between the images of the two threads upon each retina.

(3) A particular sensation — a sensation of bitter, *e.g.* — may last for a few moments or for a considerable length of time, its quality remaining unchanged. How much time must a sensation quality be allowed, if it is to be a full and adequate sensation?

Method. — One instance of the way in which this question is answered may again suffice.

To find the least noticeable duration of *pressure.* — For this purpose we require a small toothed wheel of hard wood. The arm is placed comfortably upon a sloping arm-rest, in such a way that the tip of the first finger can be laid lightly upon the teeth of the wheel. When the wheel turns slowly, we have a series of distinct pressure sensations, one from each tooth. But at a certain rate of rotation, we lose the distinct pressures, and have a perception of roughness, like that obtained by passing the finger over velvet; while if the teeth strike at a still higher velocity, the perception becomes indistinguishable from that of a perfectly smooth surface, such as marble. We must ascertain the highest speed at which the wheel can be revolved, and still give a series of distinct pressures. Dividing the time of revolution by the number of teeth, we get the minimal duration of pressure sensation required.

We must note here that a sensation does not come to an end at the moment when its stimulus ceases to act. If we look at a bright light, and then close our eyes, we see on the black background a coloured patch, of the same form as the light. It may persist for several minutes. If we blow out a lighted match, and wave it round while the burned end is still glowing, we see a red circle in the air; the red sensation at any point upon the circle persists until the match has returned again to that same point. This is why a disc composed of black and white sectors looks grey when it is rotated (§ 12); the black and white stimuli follow each other so quickly that their succession is the same, for the sense organ, as actual simultaneity.

The after-sensations, or after-images, as they are called, are of very different duration in the different sense departments. Thus,

the total duration of a loud sound or heavy pressure is considerably less than that of even a moderately strong visual or temperature sensation.

We cannot say in definite terms what is the minimal intensity, duration or extent of a particular sensation quality. The chief reasons for this are the following. (1) Although one man may be able to distinguish as many qualities of noise as another, it does not follow that he can hear equally faint sounds. That is to say, the stimulus which arouses sensation in one case may prove to be too weak in another, even if the two sense-organs are perfectly normal. (2) A stimulus which is effective at one part of the sense-organ may be inefficient to call forth sensation at another. A weight which excites the sensation of pressure upon the finger-tips is not noticed when laid on the back of the hand (intensity); and threads which seem just separate when directly looked at appear to be a single thread if observed indirectly, from the side of the retina (extent). (3) The just noticeable intensity of stimulus depends upon its own extent and duration. A light which is too faint to be seen at once may produce a sensation if it continue for some time together; and a faint speck of light may be invisible, though an extended light of the same intensity would be easily seen.

No general table of minimal values can be made out, therefore. They must be determined afresh in every series of experiments for which a knowledge of them is required.

It may be remarked here, in passing, that the 'duration' of sensation is never a bare, unchanging persistence or continuance, but always a rise-poise-fall. The sensation does not set in as

perfect sensation, but 'comes to a head'; then it remains for its normal period, which varies from sense-department to sense-department; and then it sinks, fades out. The attribute of duration, understood in this way, is the chief factor in constituting the mental element a *process*. We cannot always distinguish the three part-durations in a given sensation; a sensation of tone, *e.g.*, may seem to begin and end quite sharply and cleanly. But their differences are very noticeable in sensation-complexes, — perceptions and ideas. Thus the notes from the brass-wind and wood-wind instruments could be distinguished, even if alike in all other respects, by differences in their 'rise.' The brass-wind sets in heavily, lumberingly; the wood-wind lightly, alertly, flexibly. — *Cf.* § 49.

§ 25. **The Maximal Intensity, Extent and Duration of Sensation.** — (1) The maximal intensity of sensation is that intensity which cannot be increased by any further increase of stimulus. It seems probable that the greatest intensity which a sensation quality can attain is its intensity at the moment before pain or nausea appears. For though the quality of pain or nausea does not wholly destroy the original qualities of blue or *c*, pressure or salt, it so obscures them that we do not know whether they undergo change with further increase of stimulus or not. For all practical purposes, then, sensation intensity does not increase beyond the point at which a stimulus becomes painful or nauseating.

Method.—To determine the maximal intensity of sweet, *e.g.*, we must increase the intensity of a sweet stimulus by slow degrees until we reach the point at which the sweetness is 'sickly' and 'disgusting.' The amount of sweet stimulus which is just not sickly is the equivalent of the maximal sweet sensation.

There are two reasons why we cannot ascertain the maximum of sensation intensity with any great accuracy. (1) The sense-organ may be so much fatigued by a succession of very strong

stimuli that it refuses to act at all. The ear may be 'deadened,' smell may be 'blunted,' before the really maximal intensity of stimulation has been reached. (2) We can work only in one direction, up towards the stimulus which produces a maximal sensation. If we began to experiment with a stronger stimulus, we might injure the organ. Now we have seen that when experiments are all made in one definite direction, the subject is not impartial; he expects or anticipates the result of the experimental series. Pain or nausea will occur, therefore, earlier than it should; and the maximal intensity obtained will, in every case, be too small. Could we reverse our procedure, and come down to the maximal stimulus, we should be able to correct the error of expectation by averaging.

(2) The maximal extent of a visual quality is produced by a stimulus which completely fills the field of vision. The maximal extent of cutaneous or articular pressure is produced by a stimulus which affects the entire surface of the skin, or the whole extent of the articular surfaces from which the sensation proceeds.

Method. — If we immerse the body in water of a neutral temperature, we obtain a maximally extended sensation of cutaneous pressure, without complication by temperature sensations. A maximally extended grey is obtained when we look straight before us in a dark chamber; a maximally extended blue, when we look directly at the sky under such conditions that there is nothing to 'break the view,' — *e.g.*, as we lie on our back on a hill-top.

(3) The maximal duration of the various sensations has not been investigated. Many qualities, if long continued, pass over into pain; *e.g.*, shrill tones. Others, it would seem, might be prolonged indefinitely; *e.g.*, grey, a moderate warmth.

§ 26. **The Relation of Intensity, Extent and Duration to Quality of Sensation.** — The foregoing Sections have

brought out several differences between quality and the other attributes of sensation. One difference, a difference in the *importance* of the attributes to sensation as an elementary conscious process, we have emphasised previously by saying that intensity, duration and extent are always the intensity, duration and extent of some quality (§ 8). Quality is the most important attribute. The further distinctions which we are now able to draw are four in number. (1) Knowledge of the number of qualities helps us in our analysis of consciousness; knowledge of the number of intensities, etc., does not. (2) Knowledge of the number of qualities helps us to ascertain the bodily conditions of sensation; knowledge of the number of intensities, etc., does not. (3) Quality is absolute; the other sensation attributes are only relative or comparative. (4) Quality is individual; the other three attributes are common or general.

(1) Two sensations which differ in quality are two different sensations. But a sensation may differ widely in intensity,[1] extent or duration, and yet remain the same sensation. Since the first task of the psychologist is to analyse consciousness into its elements, he is obliged to count up the total number of sensation qualities. Ignorance of any one of them would mean that his analysis was incomplete, and his final account of mind so far wrong. But he is in no way assisted by a list of the possible intensities, etc. These are not new conscious elements, but only degrees or amounts of elements already known. (2) We laid it down in our definition of sensation that the mental process is always connected with a bodily process in a definite bodily organ. It follows that every sensation quality is connected with a different kind of bodily process. Hence it is necessary for us to know the number of sensation qualities, if we are to give a complete descrip-

[1] With the single exception of visual sensations; *cf.* §§ 12, 24.

tion of the bodily processes connected with sensations. Our view of the way in which the ear works, *e.g.*, depends upon the number of sensations obtainable from it. There is no similar reason for knowing the number of sensation intensities, etc.; for it is clear that one and the same kind of bodily process may last for a longer or shorter time (duration of sensation), be more or less widely diffused within the bodily organ (extent of sensation), and be more or less well-marked (intensity of sensation) in different instances. (3) There is nothing absolute about an intensity, etc., as there is about a quality; we estimate intensity always by comparison with other intensities. Our use of terms indicates this. 'Blue' means something fixed and absolute; but 'large' is altogether relative or comparative: a 'large' beetle, a 'large' table, and a 'large' village refer to objects of very different absolute sizes. If we had our full list, therefore, we could do nothing with it; its terms would lose all definite meaning as soon as they were taken out of the list, *i.e.*, as soon as it became impossible to compare them with the other terms. (4) No two elementary processes have the same quality. They may have the same intensity, extent and duration; for intensity and duration are universal attributes, common to all sensation processes alike, while extent is common, *e.g.*, to all sensations from the eye. Not only, then, is quality absolute, and intensity, etc., relative; quality is an individual attribute, while intensity, etc., are common characteristics of different elements.

Now an individual fact requires individual explanation: we found it necessary to give one account of the action of light on the eye, another of the action of sound on the ear, etc. But a common or universal aspect of all sensations should receive a general explanation. May we not be able, then, instead of dealing with each organ separately, to give a single account of what goes on in all the bodily organs when a sensation changes in intensity, etc.?

This is the question which was referred to in § 23 as growing out of the discussion of the first two questions propounded in the present chapter. The third question there raised, and judged unanswerable, we have found to be not worth answering. The

new question, on the other hand, is one of the most important in the whole sphere of sensation psychology. Very many experiments have been made upon our estimation of intensities (Weber's law), extents (eye measurement) and durations (time sense): we must briefly review these before we can answer it.

§ 27. **Weber's Law.** — We have seen that some stimuli are too weak to produce a sensation. Every one must have noticed the further fact that a stimulus may be of considerable intensity, and yet not strong enough to add to the intensity of a sensation already existing. If a candle is lighted in the room in which we are sitting on a dull winter's afternoon, the room becomes quite noticeably brighter; but if the same candle is lighted in the same room on a sunny morning, it makes no appreciable difference in the general illumination. If we dissolve an extra spoonful of sugar in a cup of coffee, we make it very perceptibly sweeter; but if we stir the same amount of sugar into a cup of honey, we do not find that there is any difference in the taste. Let us see what follows from this fact in a particular series of experiments.

Suppose that we are investigating the intensity of noise. We shall begin with a stimulus of moderate intensity: say, the noise made by the fall of an ivory ball upon an ebony plate from a height of 90 cm. We will call the intensity of this sensation 1. If we gradually increase the height of fall, we shall reach a point at which the noise of the fall is just noticeably greater than the original noise. We may call the intensity of this second sensation 2. If we further increase the height of fall, we shall presently get a noise, 3, which is just noticeably louder than 2; and so on. Now what are the different heights of fall — *i.e.*, intensities of stimulus — necessary to arouse

sensations of the intensities 2, 3, 4, etc.? The stimulus required for a sensation of the intensity 1 was a fall of 90 cm. That required for intensity 2 was a fall, let us say, of 120 cm.; we were obliged to add 30 cm. to the original 90 cm. Will the stimulus required for the sensation intensity 3 be a fall of 150 (120 + 30) cm.; that for intensity 4, a fall of 180 (150 + 30) cm., and so on?

However natural it may seem to reply to this question in the affirmative, the facts stated just now show that the answer would be incorrect. Dull daylight + candle-light gives a stronger sensation than dull daylight; but bright sunlight + candle-light is not stronger than bright sunlight. On the same principle, a fall of 90 + 30 cm. gives a louder sound than a fall of 90 cm.; but a fall of 120 + 30 need not give a more intensive sensation than a fall of 120. The stronger the stimulus already is, the greater must be the addition made to it if the sensation which it arouses is to increase in intensity. An addition of 30 cm. suffices to raise the intensity of sensation from 1 to 2; but if we are affected by the stronger stimulus 120 cm., we must add more than 30 to it to change intensity 2 to intensity 3. In other words: change in the intensity of sensations does not keep even pace with change in the intensity of the stimuli which occasion them.

Experiment enables us to replace this general statement of the relation of sensation intensity to stimulus intensity by a definite scientific law. *If sensations are to increase in intensity by equal amounts, their stimuli must increase by relatively equal amounts.* If the increase of 90 cm. to 120 (*i.e.*, increase by $\frac{1}{3}$) raises the intensity of sound from 1 to 2, then 120 must be increased by $\frac{1}{3}$ of itself, *i.e.*, by 40 cm., if the sensation intensity is to rise

from 2 to 3; and 160 must again be increased by $\frac{1}{3}$ of itself, *i.e.*, by 53 cm., if the intensity of noise is to rise from 3 to 4. In the same way, a stimulus of 30 cm. must increase to 40, and a stimulus of 60 cm. to 80, if we are to obtain equal differences in the intensity of the sensations corresponding to them. This law — that equal differences in the intensity of sensation are produced by relatively equal differences in the intensity of stimulus — is known as Weber's law.[1] It has been found to hold good for stimuli and sensations of widely different intensities in several sense departments, — indeed, in all those which have been thoroughly investigated. It is of especial importance as the first law, in the scientific meaning of the word, discovered by psychology.

The numerical expression of the law (*i.e.*, the exact ratio in which stimuli must increase to produce equal differences of sensation intensity) is different in the different sense departments. (1) Weights laid upon the finger-tips must increase by one-twentieth to produce a noticeable difference in the intensity of *pressure*; (2) *noise* stimuli must increase, as in our illustration, by one-third; (3) *brightness* stimuli by one-hundredth; (4) *strain* stimuli — lifted weights — by one-fortieth; (5) *smell* stimuli by between one-third and one-fourth. There are indications that (6) intensities of *tone* and (7) of *taste* (salt and bitter) obey Weber's law, but no exact statement can be made with regard to them. Whether the law holds for either or both of the temperature

[1] Ernst Heinrich Weber (see p. 32 *supra*) held successively the chairs of comparative anatomy, human anatomy and physiology in the University of Leipzig (from 1818 until his death). The first statement of his law is to be found in a paper *De tactu* ("Upon Touch"), published in 1834. It runs as follows: *In observando discrimine rerum inter se comparatarum non differentiam rerum, sed rationem differentiæ ad magnitudinem rerum inter se comparatarum percipimus.* ("In observing the difference between compared objects, we perceive not the [absolute] difference between the objects, but the proportion which the difference bears to their magnitude.")

senses is an open question. No investigation has been made of any organic sensation other than strain.

The law may be phrased mathematically as follows: If sensation intensities are to increase in arithmetical progression, stimulus intensities must increase in geometrical; or, more shortly: Sensation increases as the logarithm of stimulus.

Method. — To find the numerical expression of Weber's law for *noise.* — An ivory ball is let fall, from two different heights, upon a hard-wood plate. The difference of intensity between the two sounds (*i.e.*, the difference between the two heights of fall) must be slight. The two sounds are given in irregular order in different experiments (to avoid the influence of expectation), and the subject is required to say, in each case, whether the second is louder or weaker than the first. In 100 experiments he will give a certain number of right answers, and a certain number of wrong.

The method assumes that if the two sounds are just noticeably different in intensity, the subject will give about 80% right and 20% wrong answers. This proportion is calculated by what mathematicians call the 'law of probability.' Now suppose that a certain difference gave 70 right and 30 wrong answers in 100 experiments. We could calculate, by aid of the integral calculus, how much larger the difference must have been to give 80 right and 20 wrong, — *i.e.*, to be just noticeable. The calculated difference (difference of height of fall) is the numerator, and the original intensity (original height of fall) of the weaker sound, the denominator, of the fraction which expresses Weber's law.

§ 28. **Eye Measurement.** — We have found a general law governing the relation of sensation intensity to stimulus. Is there any similar law governing the relations of stimulus and sensation extent? Nothing can be said by way of answer to this question in the sphere of pressure (whether cutaneous or articular). A large number of experiments have been made, however, upon what is termed 'eye measurement'; that is, upon the accuracy of our estimation of visual extents (lines).

If a horizontal line, of moderate length, is bisected, and one of the halves gradually lengthened, the eye will find a difference between the two parts when the larger becomes one-fiftieth longer than the smaller. This rule holds good for stimuli of widely different absolute extent (lines of widely different length).

Extent is one of the necessary attributes of visual sensations; whenever we see, we see something extended. But it does not follow from this that extents are compared or estimated as extents, *i.e.*, that we can make a direct judgment of the relative lengths of two lines, without calling in the aid of other attributes of sensation. The rule given above — that equal additions to the extent of sensation mean relatively equal additions to the extent of stimulus — cannot but suggest Weber's law, the general formulation of which is precisely the same. The rule suggests, that is, that we compare or estimate extent of sensation by the help of the intensity of some attendant sensation.

FIG. 5. — Illustration of Weber's Law in the sphere of eye-measurement. The length of *b* stands midway, for sensation, between the lengths of *a* and *c*. If the lines are measured it will be found that $a : b = b : c$.

There is good reason for thinking that our estimation of visual extent is originally made by the help of the intensity of strain sensations. Each eye is slung in its socket upon six separate muscles. When we compare two lines, the natural thing to do is to 'run the eyes along' them; and this movement of the eyes calls forth sensations of muscular contraction and of tendinous strain. A longer line occasions a more severe (stronger) strain, and a shorter line a less severe strain. We estimate extent in terms of intensity.

The numerical expression of Weber's law for strain intensities in experiments with lifted weights is one-fortieth. It is only to be expected that the fraction should be somewhat less in the case of the eye. The eye is constantly engaged with extents

and their estimation, whereas the hand and arm are not so highly practised in the comparison of lifted weights. And the eyeball, with its six muscles and the tendons attaching to them, is set by itself in a bony socket, out of the reach of disturbance from the rest of the body; whereas the muscles and tendons of hand and arm interact in a much more complex way, and are liable to disturbance from shoulder, back, etc., — indeed, from all the muscles and tendons employed to maintain a particular bodily attitude.

It must not be supposed, however, that our judgment of the extents of two lines in a particular experiment is necessarily based upon the intensities of strain sensations coming from the tendons of the eye muscles. The further we advance into psychology, the more clearly shall we see that the mind can travel by many roads to the same result. We may 'remember' an event in half-a-dozen different ways; we may 'compare' visual extents by half-a-dozen different methods. The natural and original way to compare them is, in all probability, by aid of the intensity of attendant strain sensations; if we take this way, Weber's law will, of course, be found to govern our judgment.

Method. — Three white threads are stretched vertically over a grey background. The distance 1–2 is objectively equal to the distance 2–3. The former distance remains constant throughout the experiment. Thread 3 is now gradually moved outwards, till 2–3 seems just longer than 1–2. Owing to the error of expectation (§ 24), the judgment 'longer' will come too soon, *i.e.*, the estimation will be more accurate than the observer's average estimation. Thread 3 is then set further outwards, and from that point moved slowly inwards, until the two distances are apparently equal again. The judgment of equality comes too soon, *i.e.*, is less accurate than the observer's average judgment. The experiment is now repeated in the reverse direction. We start out from objective equality of 1–2 and 2–3, and move 3 inwards, until 2–3 is just perceptibly shorter than 1–2. The judgment is too accurate. Then, beginning from a point further inwards, we move 3 out, until 2–3 is apparently equal to 1–2. The judgment is too inaccurate. — The whole procedure is now repeated, except that

the distance 2–3 is kept constant throughout the experiments, while the distance 1–2 is varied.

The eight judgments thus obtained are averaged: and the difference between the constant distance and this average gives us a measure of the subject's accuracy in the discrimination of horizontal extents.

§ 29. **The Time Sense.**—The question of this Section is similiar to those of the two preceding: Is there any general law governing the relation of stimulus to sensation duration? or, as it has more often been phrased: Is there any general law governing our estimation of time intervals? A time interval is never an 'empty' time; if it is conscious, it is always the duration of something, some conscious process or processes. Psychologically regarded, 'interval' and 'duration' are convertible terms.

Experiments upon the estimation of intervals (durations) are grouped together under the heading of the 'time sense.' It must be borne in mind that this expression is merely figurative. We have no special sense of time, any more than we have an intensity sense or an extent sense. All sensations have duration, but we have no sensation of duration.

It has been found by experiment that judgments of the relative length of intervals (durations) are of three distinct kinds, according as the intervals themselves are shorter than half-a-second, longer than three seconds, or lie between these time limits.

(1) Our estimation of time intervals of less than half-a-second's duration is very accurate. We cannot as yet say with any degree of certainty upon what psychological grounds the judgment that one such interval is longer or shorter than another is based. But it is never a direct

judgment of duration, *i.e.*, a judgment based upon the estimation of two conscious durations. Hence we need not consider it here.

All that we know at present of these judgments (beyond the fact that they are not judgments of duration) is that they vary with the sense department from which the stimuli which limit the intervals are taken, with the rhythm and accent of these stimuli, and with the direction of the attention to one stimulus or another.

(1) If two equal intervals — say, of a quarter of a second's duration — are given, the one bounded by visual and the other by cutaneous (pressure) stimuli, the latter appears to be considerably the shorter of the two. This is because the visual after-sensation (§ 24) lasts longer than the cutaneous, and the 'visual' interval is thus extended in a way in which the cutaneous interval is not.

(2) When we listen to a rapid series of taps or clicks, we find ourselves 'forced,' as it were, to accent some more strongly than others; the sounds 'fall' into a rhythm. Suppose that we have three taps, *i.e.*, two intervals. If we accent the first, — 1′ 2 3, — the first interval is judged to be the longer; if we accent the second, — 1 2′ 3, — the second; if the third, — 1 2 3′, — the first again. The effect of accent is to lengthen the following and shorten the preceding interval. If the series really increases in loudness, the intervals seem to grow shorter; if it decreases, they grow longer. (3) A chance direction of the attention has the same effect as accentuation or real change of intensity of the limiting stimuli. Thus it may reverse the judgment instanced under (1). There is here no direct comparison of durations; our judgment of duration depends entirely upon the power of the limiting stimuli to hold the attention. — The phenomena of accent can be observed in the ticking of a watch (four or five ticks to the one second) held to the ear.

(2) Estimation of intervals longer than three seconds is an estimation of duration, but not a direct estimation. Our judgment that one interval is longer than another is based principally upon the difference in the number of mental processes which ran their course within the two total dura-

tions. The more processes introspection shows to have occurred in an interval, the longer is that interval judged to be. These intervals, also, may be passed over here.

(3) Durations which lie between the limits of half-a-second and three seconds are estimated as durations. For their estimation the law holds that equal differences of conscious duration are produced by relatively equal differences of stimulus duration. That is, if time a is to seem as much longer than time b as time c seems longer than time d, the proportion must hold that $a-b:b::c-d:d$.

We are again reminded of Weber's law. And indeed, just as estimation of visual extents is based upon intensities of strain sensation (the sensations proceeding from the tendons of the eye muscles), and thus follows Weber's law, so apparently is the estimation of these time-intervals based upon intensities of strain sensation, — and the law formulated is not really a duration law, but Weber's law itself. When we try to discover by introspection what means we have used for our comparison of two durations of this third kind, we find that strain intensities have played a great part in the formation of the judgment. The strain sensations come (1) from the expectant attitude of the whole body, and (2) from the adjustment of the sense-organ to the stimuli which limit the intervals to be compared. We estimate duration in terms of intensity: the more intensive the strain, the longer must the interval have been; the less the strain, the shorter the time.

Again, however, the natural and original way (§ 28) need not necessarily be followed; and hence the results of experiments upon the estimation of these 'moderate' intervals do not always agree. Much work remains to be done, before the psychological facts upon which the different time judgments are based can be completely described.

Method. — An electric hammer is connected with an electric clock in such a way that it gives three sharp taps upon its base at the required intervals. The subject has to compare the lengths of the two intervals, just as he would compare two intensities or

extents. We may employ the method of gradual change (§ 28) increasing and decreasing one interval until a difference between the two is remarked, or the method of right and wrong cases (§ 27), working with constant intervals which are very little different.

Or we may allow the hammer to give two strokes — one duration — only, and require the subject to arrest the electric clock (by pressing a key) as soon as a time has elapsed which he judges to be equal to the given time. The errors which he makes in a series of experiments furnish a measure of the accuracy of his estimation of duration.

§ 30. **The Meaning of Weber's Law.** — We can now proceed to answer the question of § 26: What goes on in the bodily organs when a sensation changes in intensity? The psychological facts embraced under Weber's law must be brought into connection with what physiology tells us of the effect produced upon nervous substance by stimuli of different intensities.

(1) We know that nervous substance resists the incoming of stimulation. The resistance which it offers can be overcome only by stimuli of a certain strength. This physiological knowledge enables us to understand why very weak stimuli are not sensed at all: they are too weak to overcome the resistance which they encounter in the nervous centres.

(2) Weak stimulation makes the nervous substance more excitable; strong stimulation leaves it less excitable. Hence Weber's law does not hold for stimuli which approach to minimal or maximal values. As the law holds over a wide range of stimuli, *i.e.*, for all those of 'moderate' strength, we must suppose that moderate stimulation does not change the excitability of nervous substance.

(3) The fact that moderate stimulation does not alter

nervous excitability, taken together with the fact that nervous substance resists the incoming of stimuli, accounts for the general rule that change in sensation intensity does not come with every change in the intensity of stimulus. It might be thought that, when once an excitation had been set up, the resistance of nervous substance had been once for all overcome, and that we ought, consequently, to sense any addition made to the strength of stimulus. But the moderately excited nervous substance offers as much resistance as the unexcited to the incoming stimulus; and a small addition to the strength of the latter is, therefore, not sensed.

(4) Physiology asserts that a stimulus which affects a particular sense-organ not only produces an excitation within that organ, but is more or less widely diffused over the whole body. Thus a light-stimulus not only sets up an excitation within the retina, but also has an effect upon circulation, respiration, etc. Some part of the energy of every stimulus, then, is lost for sensation.

Weber's law shows that the part which is lost (and consequently the part which is used) always bears the same relation to the total stimulus. A light of 100 candle-power is just different from a light of 101; a light of 200 from a light of 202. Just the same proportion of light is lost (and just the same proportion used) in the one case as in the other.

Since strong stimulation decreases the excitability of nervous substance, it is intelligible that the fraction which expresses the relative increase of stimulus necessary to produce a just noticeable increase of sensation should be larger in the case of strong stimuli than in that of moderate (Weber's law). And we find that while the just noticeable difference of noise is one-third for

moderate sounds, it is much more than one-third for extremely loud sounds.

Since weak stimulation increases the excitability of nervous substance, we might suppose that the corresponding fraction would be smaller than that which expresses Weber's law. The reverse is the case: the fraction is larger for less than moderate, as it was for more than moderate stimuli. The just noticeable difference of very faint noise, that is, is also more than one-third.

The reasons for this, at first sight anomalous, fact are as follows. (1) It is difficult to hold the attention upon a very weak stimulus. Hence small differences between very faint sensations may pass unnoticed (*cf.* §§ 38, 41). (2) The sense-organs are at all times subject to the action of weak internal stimulation. In some cases this stimulation is strong enough to maintain a permanent sensation (*cf.* the grey of the retina, § 24), in other cases it only occasionally reaches the necessary strength (we are ordinarily insensible, *e.g.*, to the internal ear-noises, corresponding to the pumping of blood through the arteries of the internal ear): it is always present in some degree. When we state numerically the increase of stimulus required to produce an increase of sensation, we make this increase a fractional part of the external stimulus alone: it should properly be calculated as a fractional part of external *plus* internal stimulus. Thus if a very faint sound had to be increased by one-half, that the two might be sensed as different, we should say that Weber's law did not hold: Weber's law demands a difference of one-third only. Yet this addition, which is one-half of the external sound, might be one-third of external sound *plus* artery-sounds, — if we could but measure the latter. In general terms, the deviation from Weber's law may oftentimes be apparent only, not real. (3) If the deviation be real, we may suppose that the increase of nervous excitability, within the time limits of a single experiment, is not sufficient to counterbalance the resistance offered by nervous substance to the incoming of stimulus.

(5) The numerical expression of Weber's law is different in the different sense departments. By the eye we

can appreciate a difference of one-hundredth in the intensity of a stimulus; by the ear, a difference of one-third only. This shows that the visual apparatus has been brought, in the course of organic evolution, into relatively finer intensive adjustment to its special environment than has the auditory apparatus. Whether the determining factors be in the sense-organ, or in the cortex, or in both, cannot be said. It is highly probable, however, that the specific excitability of the sense-organ is involved in every case.

It is plain from these considerations that the bodily conditions of sensation intensity are of a general nature, that they are alike in all the sense-organs. And wherever our estimation of durations and extents is based upon differences in the intensity of strain sensations, the bodily conditions of these aspects of sensation are the same as the conditions of intensity. Weber's law 'explains' the phenomena of intensity, extent and duration, over the whole domain of sensation, in the sense in which our account of the structure and function of eye or ear 'explains' the qualities of vision or audition.

References for Further Reading

Ebbinghaus, *Grundzüge*, I, §§ 38, 40, 44–47.
James, *Principles*, I, xiii (pp. 533–549), xv; II, xx (pp. 133–137).
Külpe, *Outlines*, §§ 24–26, 55, 63–65.
Wundt, *Grundzüge*, I, viii; II, xiii (§ 3), xvi (§ 5).
Consult also G. E. Müller, *Grundlegung d. Psychophysik*, 1878; and, for the 'time sense,' a series of articles by E. Meumann, in the *Phil. Studien*, 1892–1896.

CHAPTER V

AFFECTION AS A CONSCIOUS ELEMENT. THE METHODS OF INVESTIGATING AFFECTION

§ 31. **The Definition of Affection.** — We can quite well conceive of a mind which should be entirely made up of sensation processes and the processes arising from the interconnection and intermixture of sensations (perceptions and ideas). Certain mythologies represent the divine mind to be of this type: it is omniscient (*i.e.*, the ideas of which it consists form the total sum of all possible ideas), but it is also indifferent (unfeeling) and contemplative (inactive). Mind as we observe it, however, is of a very different nature. The living organism is exposed through its sense-organs to all manner of stimuli, and its mental processes are in large measure the sensation processes directly aroused by these stimuli. But the organism is not indifferent. It not only senses: it *feels*. It not only receives impressions and has sensations: it receives impressions in a certain *way*.

When we have spoken in previous Sections of the effect of stimulation upon a bodily organ, we have thought of the body as entirely passive. We have pictured the stimulus as forcing its way through the organ, and setting up some change in it and in the brain, just as we might have pictured the photographer's acid eating away the surface of the sensitive plate. But the body is alive; and

life means the balance of power (more or less perfect) in the perpetual conflict of two opposing forces, — growth and decay. No impression can be made upon the living body that does not tend in some way to change this balance, — that does not tip the scale on one side or the other, furthering growth or hastening decay. Hence every stimulus that produces a special effect, within a certain organ and the area of the brain cortex with which that organ is connected, must also produce a general effect upon the nervous system (*cf.* § 30). It must help either to build up nervous substance or to break it down. The organism is a whole: and what affects it in either of these ways at one part, must affect it as a whole, in all. The conscious processes corresponding to the general bodily processes thus set up by stimuli — processes not confined to definite bodily organs — are termed *affections*.

It will be readily understood that we cannot classify affections as we classified sensations; that there are no different orders or groups of affections as there are of sensations. There are many sense-organs, and each organ furnishes one or two groups or classes of sensations: but there is only one affective organ, — the whole body. It will be seen, further, that there cannot be so many qualities of affection as there are, *e.g.*, of sight or hearing. We have a large number of sensations of colour, because ether-waves of different lengths set up different chemical processes within the retina; we have a large number of sensations of tone, because air-waves of different lengths throw different fibres of the basilar membrane into vibration. But there are only two bodily processes to give rise to affective processes: the building-up process (anabolism) and the breaking-down process (catabolism). We

should expect, then, to find no more than two qualities of affection. And introspection tells us that the expectation is correct. The anabolic bodily processes correspond to the conscious quality of *pleasantness*, catabolic processes to that of *unpleasantness*. These are the only qualities of affection.

In our definition of sensation, we took account of its simplicity as a conscious process, and of its bodily conditions. Of the simplicity of affection — pleasantness and unpleasantness — there can be no doubt: neither of its two qualities can be analysed into more simple and elementary components. It is, as we have seen, unlike sensation in that it is not connected with a bodily process in a definite bodily organ. The organism, as a whole, receives the impressions made upon it in a certain way: an affection is the conscious process arising from its 'way of receiving' a particular impression.

§ 32. **Affection and Sensation.** — The processes of pleasantness and unpleasantness seem, at least in many cases, to bear a strong resemblance to certain concrete experiences which we have analysed, provisionally, as complexes of sensations (§ 21). Thus pleasantness may suggest health, drowsiness, bodily comfort; and unpleasantness pain, discomfort, overtiredness, etc. Hence it might be supposed — notwithstanding the statements of the preceding Section — that the two qualities which we have ascribed to affection are in reality two new qualities of organic sensation; perhaps common, like pressure, to various groups of sensory nerves, perhaps restricted, like strain, to one single set of bodily organs.

Now there can be no doubt of the resemblance in the instances cited. But the reason of it is simply this: that

health, drowsiness, and bodily comfort *are* pleasant, *i.e.*, that pleasantness is one of the constituent processes, running alongside of various sensation processes, in the total conscious experience which we call 'health,' etc.; and that pain, bodily discomfort, and overtiredness *are* unpleasant, *i.e.*, that unpleasantness is one of the processes contained in each of these complex experiences. Beyond this there is no resemblance: a sensation process is radically different from a pleasantness or unpleasantness. The following considerations will be enough to make the fact clear.

(1) The first great difference between sensations on the one hand and pleasantness and unpleasantness on the other is that the former are looked upon as more or less common property, — as inherent, so to speak, in the objects which give rise to them, and therefore as possible parts of every one's experience, — while the latter are our own peculiar property. Blue seems to belong to the sky; but the pleasantness of the blue is in me. Warmth seems to belong to the burning coals; but the pleasantness of the warmth is in me. Regarded from the point of view of the psychologist, blue, warm and pleasant are all mental processes, all facts of one's own experience; regarded from the point of view of ordinary life, — the point of view which shows mind as *function* only, and not as structure, — blue and warm are somehow detachable from oneself and one's personal experience, whereas pleasantness is always within oneself. The distinction is unhesitatingly drawn in popular thought, and clearly shown in language. And while the psychologist cannot accept the popular statement of it, without qualification and reserve, he cannot but admit that it points to a real difference

between sensation and affection as factors in mental experience, — a difference which he must seek to make explicit in his definition of the two processes.

The same difference is observed even when we compare the affective processes with those sensations which are occasioned from within, by a change in the state of a bodily organ. The unpleasantness of a toothache is far more personal to me than the pain of it. The pain is 'in the tooth'; the unpleasantness is *my* discomfort.[1] — Summing up, then, we may say that sensations are the *objective* and affections the *subjective* mental elements.

(2) Our last illustration has brought to light a second difference between the sensation and the affection. The pain of the toothache is *localised* at a particular place, 'in the tooth'; but the unpleasantness of it suffuses the whole of present experience, is as wide as consciousness. So too when the discomfort of a cramped position makes me shift in my chair: the muscular and circulatory pains proceed from certain parts of the body, but the unpleasantness pervades the whole consciousness of the moment. Satiety and easy digestion dispose one to a favourable view of things in general: the sensations which enter into them are referred to the alimentary canal, but their pleasantness is spread over the whole mental horizon.

This difference, then, may be expressed by the statement that sensations are *local*, affections *coextensive with consciousness*.

[1] The word 'pain,' as used in ordinary conversation, often means the whole toothache experience: pressure sensation, pain sensation and unpleasantness. In the text the word is used in its strict meaning, to indicate the organic sensation in the complex (§ 21).

It is an obvious corollary to this statement that two affections cannot run their course as conscious processes at the same time. Nothing can be at once pleasant and unpleasant.

'Why, then,' it may be asked, 'do we hear of "mixed feelings"? Why does Shakespeare make Juliet say: "Parting is such sweet sorrow" — *i.e.*, a pleasant unpleasantness? Or how can Tennyson's Geraint look at the dinnerless mowers with "humorous ruth" — *i.e.*, again, with a pleasant unpleasant feeling?' The answer is that the nervous system may very well be exposed, at different quarters, to stimuli some of which are catabolic and some anabolic; some of which, that is, if felt by themselves, would be felt pleasantly, and some of which, if felt alone, would be felt unpleasantly. And the attention may oscillate, as it were, between the one group and the other; so that pleasantness and unpleasantness succeed each another in consciousness with great rapidity. The boy leaves home for school with 'mixed feelings'; he is sorry to go (unpleasantness), but his new watch partly reconciles him to his fate (pleasantness). Nevertheless, at any given moment he is either glad or sorry; watch-consciousness and parting-consciousness succeed each other rapidly, but never overlap; there is no moment of combined joy and sorrow.

We see now that the Figure of mind (p. 12) is imperfectly drawn. The tangle of processes should be washed over with two contrasting colours, in irregular alternation, — the one representing pleasantness, the other unpleasantness.

(3) If we are exposed for a long time together to the same stimulus (and if the sensation which the stimulus arouses is not of a kind to pass over into pain: § 25), we cease to be affected by it at all. The cookery of a foreign country is, when we first make acquaintance with it, distinctly pleasant or unpleasant; but in either case quickly becomes indifferent. Dwellers in the country do not find the pleasure in country scents and odours that the townsman does; they have 'grown used' to their surroundings.

The whir of a sewing machine in the room above that in which we are working may at first be extremely annoying; but as we become accustomed to it, its unpleasantness disappears. The smell of the dissecting room, which sickens us at our first entry, does not affect us at all after a little time. And it is the same with centrally aroused pleasantness and unpleasantness [*cf.* (5) below]. During the first few weeks of our stay in a beautiful neighbourhood we may be continually delighted with the colours and forms of the landscape. But we soon grow indifferent to them: fields and streams and hills are seen as clearly as ever, but have ceased to excite pleasure. The beauty of a new dinner service may be remarked on with pleasure for a short time, but 'familiarity breeds' indifference. On the other hand, a piece of vulgarity which at first offends us may be taken as a matter of course if constantly repeated among those into whose company we are thrown.

Habituation to an experience, then, wears away and destroys the pleasantness or unpleasantness which originally attached to it. There is no similar destruction of sensations. The habitual sensation is not attended to; it is removed from its high place at the 'focus' and relegated to the 'margin' of consciousness; but it is not destroyed. It becomes, indeed, all the more organic to our mental make-up, all the more ingrained in conscious constitution. And if, by chance, attention is later directed to it and its affective colouring revived, we find that there is no necessary resemblance between this and the original affection. Olives, *e.g.*, are to most people positively distasteful at first trial. Presently we eat them indifferently, as regular concomitants of certain dishes. But if our neighbour is

tasting them for the first time, so that our own interest in them is rearoused, we discover that we like them.

Here, therefore, is a third cardinal difference between sensation and affection. Affection is killed by repetition of stimulus; sensation, under like conditions, becomes more and more inwoven into the texture of mind.

'But,' it may be said, 'affection is the way in which the organism receives its impressions. How, then, can anything be indifferent? We must receive impressions somehow, whether we are accustomed to them or not.' We reply that the objection does not state the facts quite correctly. Affection is not the 'way,' but the 'conscious process corresponding to the way' in which the organism receives its impressions. Just as there are stimuli which do not arouse a sensation (§ 30), so there is a way of receiving impressions, to which no conscious process whatever corresponds. To explain this, we must emphasise the biological fact of adaptation. The organism is constantly exposed to a multitude of impressions: to sights, sounds, changes of temperature, organic disturbances, etc. Every one of these does, undoubtedly, exercise a definite effect upon it, for good or for harm. But nervous substance, at the same time that it is very impressionable, is eminently adaptable. The organism adjusts itself to its circumstances, — resigns itself, so to say, to their inevitableness. When once adaptation or adjustment to surroundings is complete, the surroundings cease to be taken either pleasantly or unpleasantly: their impressions are simply received, passively and unfeelingly. Hence we may have an indifferent, as well as a pleasant or unpleasant consciousness.

'Adaptation' is a biological term. Translated into physiology it means that the disturbance of nervous equilibrium (§ 31) caused by a particular set of stimuli can be adjusted by the lower nerve-centres, without appeal to the highest co-ordinating centres [see (5) below]. There is enough energy stored in these lower centres to repair damage done to the organism by stimulation; and they have functioned in one way so often that they no

longer need direction, but can be trusted to do what is required of them when occasion arises.

(4) The more closely we attend to a sensation, the clearer does it become, and the longer and more accurately do we remember it. We cannot attend to an affection at all. If we attempt to do so, the pleasantness or unpleasantness at once eludes us and disappears, and we find ourselves attending to some obtrusive sensation or idea which we had no desire to observe. If we wish to get pleasure from a beautiful picture, we must attend to the picture: if, with our eyes on it, we try to attend to our feelings, the pleasantness of the experience is gone.

The reason for this difference will not become clear until we have discussed the relation that obtains between attention and affection (p. 143, *infra*).

(5) We saw, under (3) above, that the quality of affection is not correlated definitely, unambiguously, with the quality of stimulus: the bitter of the olive may be pleasant at one time, unpleasant at another. Neither is the *intensity* of stimulus so correlated; the strongest sensation is not always the pleasantest or most unpleasant. We have seen that sensations arise in two ways (§ 7), — from peripheral stimulation (flash of yellow light) and from central excitation (remembrance or imagination of yellow). As a general rule, 'central' sensations are much fainter and weaker than 'peripheral.' A remembered noise has hardly anything of the intensity of the noise as heard. Affection can originate in the same two ways. But 'central' pleasantness and unpleasantness are not only as strong as — they are in very many cases stronger

than — 'peripheral.' That is, the weaker sensation (the lesser intensity of stimulus) is coloured by the stronger affection.

Pleasantness and unpleasantness can be set up peripherally by an impression affecting any sensory nerve. The balance of anabolism and catabolism, of loss and gain, may be disturbed at any point of the peripheral nervous system. They can be set up centrally, again, by an excitation within any sensory area of the cortex, — the visual centre, the auditory centre, etc. But it seems to be necessary in both cases that the disturbance be not confined to a sensory centre, but extend to one of the 'association centres,' the highest co-ordinating areas of the cortex. If the experience is indifferent, — if the stimulus is too weak to force its way through the lower centres, or has become habitual, *i.e.*, can be disposed of by the lower centres, — these association areas are unaffected. They are the scene of anabolic processes (well supplied with oxygenated blood) if the experience is pleasant; of catabolic (scantily supplied with oxygen and feebly irrigated by arterial blood), if it is unpleasant.

There are very few 'peripheral' affections which can successfully compete with the 'central' affections in the civilised mind. Different men are differently constituted; we find one succumbing to the passion of sexual lust, another to the pleasures of the palate, etc. But the only peripheral affection which can be counted upon to conquer central affection in the average mind is the unpleasantness which accompanies an extreme intensity of the organic sensation of pain: and even this rule has exceptions. Instances of the contrary are plentiful: pleasure in work (central) makes us forget our dinner hour and the pleasure of eating (peripheral); the glow of pleasure attending a good action (central) leads us to go out of doors in bad weather (peripheral unpleasantness); fear of ridicule (central unpleasantness) prevents our rising to close a window in a draughty concert hall (peripheral unpleasantness), etc.

The explanation of this fifth difference between sensation and affection must also wait until we have discussed attention (§ 38).

We see, then, that there are strong reasons for regarding affection as different from sensation. It must be carefully noted that the statements just given of these reasons do not tell us *how* 'red,' a sensation, differs from 'pleasant,' an affection, in mental experience. They are sufficient indication that a real difference exists; but the difference itself cannot be described, — it must be experienced.

§ 33. **The Methods of investigating Affection.** — There are two chief difficulties in the way of affective investigation. We cannot attend to a pleasantness or unpleasantness; and we can describe our affective experience only in a roundabout way. Hence if we were confined exclusively to the employment of psychological method, — the method of experimental introspection, — we should find it very hard to give an adequate account of affective experience. Fortunately, we can supplement this direct method by an indirect, physiological method, which allows us to infer the presence and intensity of affective processes from their bodily consequences.

The second difficulty — that of describing affection — must not be confused with the difficulty of defining affection. It is just as easy to define affection as to define sensation, if we understand by definition a statement (1) of the simplicity of the processes, (2) of their bodily conditions and (3) of their qualities.

The difficulty of describing affection lies in the fact that spoken language — words and sentences — communicates ideas, and ideas only. If I say 'I am very angry,' you know that I am angry, but you do not feel my anger. A verbal description of affection is therefore always a description at second hand; it translates the affection into an idea of affection, and conveys to the hearer not a pleasantness or unpleasantness, but simply an idea of pleasantness or unpleasantness.

There is, however, an affective language proper: the language of exclamation and gesture. We have learnt, in the course of civilisation, to repress our emotions: we rarely use this language, and if on occasion we wish to do so, are apt to make ourselves ridiculous. But that the language might have been developed cannot be doubted by any one who has observed dogs and monkeys, or has seen the effect produced upon an audience by some great actor's presentation of pity or despair.

(1) *Psychological Method.* — A series is formed of stimuli which belong to the same sense department (coloured papers, woollen fabrics, etc.). Each in turn is presented to the observer, who gives it his complete attention, and when it has produced its full effect for sensation, asks himself whether it is pleasant or unpleasant, and whether it is more or less pleasant or unpleasant than preceding impressions. The rule of experimental introspection in the sphere of affection will accordingly run as follows (*cf.* § 9): *Have yourself placed under such conditions that there is as little likelihood as possible of external interference with the test to be made. Attend to each stimulus as it is presented, and, when it is removed, form an idea* (§ 59) *of the pleasantness or unpleasantness which you felt during its observation. Put this idea into words, stating* (1) *whether it is an idea of pleasurable affection, unpleasurable affection or indifference, and* (2) *in the two former cases, whether it is an idea of much or little, more or less, pleasantness or unpleasantness.* The assistant's account of the conditions, and your own verbal translation (*i.e.*, translation into ideas) of your affective experience furnish data from which other psychologists can work.

It is probable that in every series of stimuli, such as this method requires, there will be some accustomed or habitual impressions,

which are neither pleasant nor unpleasant. These must be marked 'indifferent.' Indifference is not a third affective quality: the indifferent impression is one from which affection has 'worn off.'

(2) *Physiological Method.*— Affection appears when there is a general alteration of the nervous system, including its highest co-ordinating organ, by way of anabolism or catabolism: in the one case we have pleasantness, in the other unpleasantness. Such an alteration will, of course, show itself in certain bodily effects. Seeing these effects, and knowing that the cause of them — the nervous change — is the bodily condition of affection, we are able to turn them to account for psychological purposes.

The principal bodily effects are four in number. We find that pleasantness is attended (1) by increase of bodily volume, due to the expansion of arteries running just beneath the skin; (2) by deepened breathing; (3) by heightened pulse; and (4) by increase of muscular power. Unpleasantness is accompanied by the reverse phenomena of lessened volume, light breathing, weak pulse, and diminished muscular power. There are special physiological instruments by which each of these manifestations can be measured. If we arrange them so that they record the state of the subject's pulse, muscular strength, etc., and then bring to bear upon him various forms of stimulation, calculated to call up pleasantness and unpleasantness in varying degrees, we can infer from the changes in the records how he has 'felt' from moment to moment of the experiment. Introspection is here altogether unnecessary.

Let us suppose that the subject is 'in position': the chest connected with an instrument which writes the respiration curve, the rise and fall of the chest in inspiration and expiration, the left wrist with another, which marks the pulse beats, the right leg with

a third, which registers volume, and the right hand ready at command to grip the handle of a 'dynamometer,' which will record the amount of muscular force that the hand can put forth. He is told that, whatever happens, he must remain still, in order that the various instruments may not be deranged; and he is told further that the unpleasant stimuli to be employed are not so very unpleasant that he need have any great apprehension of what will happen to him. After a short time has elapsed, a spoonful of some colourless liquid is poured into his mouth. In spite of the assurances given, the records will probably show some trace of agitation at this moment. However, if the liquid is sweet, the pleasantness of the stimulus will at once make itself apparent in the curves, and on the scale of the dynamometer. After another brief interval another stimulus is given: perhaps another sweet, perhaps a bitter, perhaps a tasteless solution. The resulting pleasantness, unpleasantness or indifference will be clearly marked by the instruments.

The general rules for the introspection of affection are the same as those for the introspection of sensation. We must be (1) impartial, (2) closely attentive to the stimuli, (3) fresh and (4) well-disposed. The last condition is especially important. For the way in which we receive impressions must naturally vary as our 'mood' varies. If we are unusually cheerful, all the stimuli of the series will tend to be pleasant; if we are depressed and melancholy, the experiment and everything connected with it are likely to be unpleasant. The subject's mood must be carefully observed and noted by the assistant before the experimental series is begun.

This last rule applies, with even greater stringency, to investigation by the physiological method. We must be quite certain that the pulse, volume, etc., recorded by the various instruments at the beginning of the experiments

represent a mental indifference on the part of the observer. The bodily expressions of affection have no value at all, unless we know precisely what the state of the body is before affection appears in consciousness. If we always begin with indifference, increase or decrease of pulse, muscular strength, etc., as recorded by the instruments from day to day, gives us a reliable measure of the variations in quality and intensity of the affective process under different experimental conditions.

§ 34. **The Attributes of Affection.** — Affection has two *qualities*, — pleasantness and unpleasantness. Each of these qualities may appear at very different degrees of *intensity*, and, when present, may last for a longer or shorter *time*. Neither, of course, has the attribute of spatial extent, though we may say, in metaphorical language, that the affection of any moment is '*coextensive* with consciousness.'

All three attributes — quality, intensity and duration — call for brief notice here.

(1) *Quality.* — We have already spoken of the general bodily conditions under which the two affective qualities appear in consciousness. But we cannot say anything certainly of the degree of nervous loss or gain which corresponds to a particular intensity of pleasantness or unpleasantness. Hence in practical life we always refer affections to stimuli, to the external occurrences which seem to give rise to them. And in recording the results of experiments upon affection — whether made by the psychological or the physiological method — we find it necessary to give the special conditions of their appearance, *i.e.*, to name the external stimuli which called them forth on each particular occasion. A general rule has

been formulated, on the basis of experiments thus recorded, to the effect that, other things equal, weak stimuli are indifferent, stimuli of moderate intensity pleasant, and strong stimuli unpleasant.

"Other things equal" is a very needful qualification. If other things are *not* equal, — if the peripheral affection be reinforced or checked by a central, — the rule does not hold. Thus, if we are seeking to ascertain the minimal sensation intensity, a weak stimulus may be absorbingly interesting, instead of being indifferent, as the rule says.

The 'weak' stimuli of the rule are those which cannot overcome the resistance of the lower nerve-centres, and force their way through them to the highest centres. Stimuli of this sort are neither pleasant nor unpleasant. 'Moderate' stimuli are those which call upon the bodily organs to exercise their normal function, and thus further growth and development. 'Strong' stimuli are those which make too severe demands upon the organs, *i.e.*, favour catabolism. The rule cannot be made more definite, since 'strong' and 'weak,' always relative terms, are here doubly relative. (1) They are relative in that they vary with the quality of sensation. It takes far more sweet to make a strong sweet than it takes bitter to make a strong bitter; it takes a far louder bass note than treble note to make a strong auditory stimulus. (2) They are relative in that they vary with the excitability of nervous substance. What is strong to one man may be weak to another, or even to the same nervous system at another time. 'Strong' and 'weak,' that is, change in meaning as the conditions change under which they are applied.

The rule only holds good, again, for stimuli of certain durations. A *weak* stimulus, long continued, has the same effect upon the organism as a moderate stimulus, operative for a short time. A stimulus of *moderate* intensity ceases to be pleasant if its operation is prolonged. We either grow accustomed, *i.e.*, become indifferent, to it, or we find it unpleasant. Physiology teaches us that a continued stimulation, to which the organism has not adapted itself,

decreases the excitability of nervous substance, making towards catabolism. For the same reason an irregular recurrence of stimulation, in whatever sense department, is unpleasant: flickering light, 'pins and needles,' jarring sounds, etc. Lastly, a *strong* stimulus, if it act only for a short time, may be sensed and felt as would a moderate stimulus, longer continued. This is seen, *e.g.*, in the carrying or lifting of weights.

(2) *Intensity.* — It has been suggested — and the suggestion is not improbable — that if the intensity of pleasantness or unpleasantness is to be increased by equal amounts, its stimuli must increase by relatively equal amounts (Weber's law). If my library contains 100 volumes, and 10 more are given me, I am as pleased as I should be by an addition of 100 to a library of 1000. At any rate, it is true, as a general rule, that what causes us pleasure and displeasure is proportional to our income, station in life, etc. A child is pleased by a gift to which an adult would be indifferent.

The stamp which completes a 'set' in the school-boy's album gives him as much pleasure as the acquisition of the last farm which completes the ring-fence gives the wealthy landed proprietor. And an ironical phrase or sarcastic expression of face wounds a sensitive mind as much as an open rebuff or direct affront affects one of coarser fibre.

(3) *Duration.* — The duration of a pleasantness or unpleasantness can hardly be estimated. It is very difficult to say just when we cease to be affected by an event and become indifferent to it. Moreover, a peripheral affection is almost invariably blended with and continued in a central; and as the two are precisely the same in quality, nothing can be said of the time at which the one ceases and the other begins.

"How delightful! — Who could have sent it!" is the exclamation that we all make when we receive an unexpected present from an unknown giver. The peripheral pleasantness is hardly there before we begin to imagine reasons for the gift, cast round for the giver, etc., *i.e.*, before a central affection is added to it. And on the other side: how much of our chagrin at a fall on a slippery path is due to peripheral unpleasantness accompanying the pain of the bruise, and how much to central unpleasantness — "How *stupid* of me to slip!"? Only in very extreme cases, during intense pain, is the affection exclusively peripheral, and in these cases there is generally a rapid passage to unconsciousness (swoon or faint).

References for Further Reading

Ebbinghaus, *Grundzüge*, I, §§ 51-54.
Külpe, *Outlines*, §§ 28, 34, 37, 39, 41.
Wundt, *Grundzüge*, I, x.
Consult also A. Lehmann, *Die Hauptgesetze d. menschl. Gefühlslebens*, 1892; and, for a phylogenetic theory of the affective processes, H. Spencer, *Principles of Psychology*, 3d edn., 1881, I, ix. For an attempt at further differentiation of affective qualities, see Wundt, *Outlines of Psychology*, 1897, § 7. For a sensation-theory of affection, see H. Münsterberg, *Beiträge zur experimentellen Psychologie*, iv, 1892.

CHAPTER VI

Conation and Attention

§ 35. **Bodily Tendency and Mental Constitution.** — In the last chapter we dwelt upon the fact that the organism receives impressions in a certain way: the consciousness of any moment is made up, not of sensations alone, but of sensations and affection. Having now examined the conscious processes which correspond to the 'impressions' and to the 'way in which they are received,' we have, in the present chapter, to consider the nature of the 'organism' itself, — to enquire whether there are any organic functions or processes, altogether independent of stimulus, with which other specific conscious processes are connected.

We may define an organism, from our present standpoint, as a bundle of *tendencies*. A tendency is, by derivation, a 'stretching towards.' The living body, as we have regarded it hitherto, consists of two things: the sense-organs and the nervous system. The sense-organs are instruments which work in pretty much the same way for all normal persons. The same sense stimulus will always give rise to the same sensation: a certain ether-wave arouses the sensation of blue in all normal eyes, a body of a certain chemical constitution arouses the sensation of sweet on all normal tongues. And at any given time, each man's nervous system — the most complicated and most

highly developed part of his body — responds, as a whole, in the same way to the same attributes of stimulus. Moderate stimulation is pleasant, excessive or intermittent stimulation unpleasant. But we have seen that there is a great difference between different nervous systems, and in the same nervous system at different times: a particular sense stimulus, while it always produces the same effects in the sense-organ and the part of the brain with which the organ is most directly connected, does *not* always produce the same effect upon the total nervous system. What is pleasant to one man now may be unpleasant or indifferent to another, and to himself at another time. As between different nervous systems, these differences show themselves antecedently to any habituation of the organism to the impression.

In biological language, the differences are differences of tendency. The nervous system has, in every individual case, certain definite leanings, a bias in certain definite directions. It is more inclined, better fitted, to receive certain impressions than to receive others. In physiological language, the functions of the nervous system differ, in degree if not in kind, in every individual case. The nervous system, regarded as a machine, is a machine which can do one kind of work and not another, — or, if it does this other, can do it less thoroughly; and the kind of work, or the thoroughness of its doing, varies from man to man.

We may compare different nervous systems to different languages. The general function of all languages is the same, — the communication of ideas; and the general function of all nervous systems is the same. But just as different languages are differently adapted to the perform-

ance of special functions, — Italian is the language to sing in, German the language to philosophise in, French the language for science, English the language of commerce and practical intercourse, — so different nervous systems are differently adapted to the performance of special functions. They have a 'tendency' towards the performance of one, while there is friction of the machinery, more or less serious, if they are called upon to perform others.

The question how tendencies originate is one for the biologist, not the psychologist, to answer. We can merely note here that some are 'natural' and some 'acquired.'

(1) *Natural Tendencies.* — The history of an individual does not begin with his first appearance in the world as an individual, an independent centre of experiences, but goes far back to the very beginnings of life. Our natural, *i.e.*, inherited tendencies are derived largely from our parents, but in part also from their parents, and in part from remote ancestors. Plainly, we cannot trace the history of such tendencies very fully or very far. But it is sufficient for our present purpose to recognise that every living being is naturally 'selective,' in greater or less degree, — has 'affinities' for certain stimuli, as chemical elements have 'affinities' for certain other elements: its surroundings do not all appeal to it with equal force; there are lines of less resistance and lines of greater resistance along which its functions may be discharged.

(2) *Acquired Tendencies.* — The strength of the natural tendencies, however, is very different in different individuals; and the child's nervous system is very plastic, very easily moulded. Hence habit may become second nature, — nay, may become (as the Duke of Wellington said) 'ten times nature': a tendency engrafted on the organism from without may come to such a growth as entirely to overshadow its natural or hereditary leanings. Many a young man whose 'taste' is for art has entered upon a business life with great reluctance and only under the pressure of necessity; but when he has assured himself a competency, and is in a position to relinquish business for his old pursuits, the routine of work has so strong a hold upon him that there is no question of any change of occupation.

Now as we have found that certain local excitations within the nervous system are attended by a specific conscious process, — sensation; and that the change of equilibrium brought about in the nervous system as a whole by the action of stimuli is also attended by a specific conscious process, — affection; we might naturally suppose that there would be a specific conscious process, a third elementary process, alongside of sensation and affection, corresponding to the bias or leaning of the nervous system. But introspection affords no confirmation of this view. It does not reveal any trace of a third conscious element, accompanying the bodily tendency, the 'set' of the nervous system for the discharge of particular functions.

On the other hand, there can be no doubt that, as the condition of mental 'constitution,' bodily tendencies are of great importance for psychology. They mark out the paths, so to speak, which mental processes in general are to follow. No specific mental process is due to them, in the sense in which the specific sensation of red is due to a special excitation of retina and visual brain centre; but they cut the channels in which the stream of conscious processes flows, and consequently determine the direction which the stream is to take.

That minds differ, although the processes which make them up are of the same nature, is obvious. Differences of mental constitution show themselves in differences of character, temperament, ability, preferred employment, etc. One man is 'steady,' another 'unreliable'; one is 'emotional,' another 'phlegmatic'; one 'talented,' another 'stupid'; one devoted to music, another equally enamoured of the study of medicine.

Many proverbial expressions bear witness to the same fact. "The poet is born, not made" and "The child is father of the man" point to the existence and persistence of a peculiar mental

constitution, — corresponding, in the one case, to a natural tendency, and in the other to natural tendencies as modified by education, *i.e.*, by acquired tendencies. When we see that a man is unfitted by character, temperament, etc., for his post, we say that he is "a square peg in a round hole"; and by his 'squareness' we mean his mental constitution, the mould of his character or the bent of his temperament. The prayer "Lead us not into temptation" is an admission that conscious processes run in certain channels more easily than in other channels, *i.e.*, in biological language, that the organism leans in a certain direction, is more impressionable by certain stimuli than by others.

We represented mind, in Fig. 1, as a complex of processes, increasing in complication from childhood to manhood, and decreasing again from middle life to old age. We now see that, if the diagram is to be accurate, it must be drawn differently for every individual mind. Bodily tendency conditions the shape of the diagram. Mind is a stream of processes flowing between banks, through channels which are now deep-cut and now shallow, which lead now in this direction and now in that, which now incline easily downwards and now run at the same level. Just as the course of a river is determined by the nature of the country through which it passes, so the course or trend of mind is determined by the nature of the nervous system, by the predominance of the one or the other biological tendency.

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To establish the fact of differences of mental constitution in a scientific way, we must observe our neighbours' minds in the light of an introspective analysis of our own. Two methods are open to us here. (1) We may compare the statements of other psychologists with our own introspective results. Then we find, perhaps, that one, wishing to recall the French equivalent of an English word, tries to remember how it *looks*, and another how it *sounds;* that the memory of one is 'mechanical,' a storehouse of separate facts, while that of another is 'logical,' the facts re-

membered falling into connection and taking their places in a coherent and unified system of knowledge; that one reaches his conclusions 'inductively,' gathering together a collection of instances, and seeking to find a single explanation for them all, while another argues 'deductively,' jumping at once from a few instances to a general hypothesis, and then testing this by applying it to other instances; and so on. (2) Or we may construct our neighbour's consciousness from his actions, reasoning by analogy that as our mental processes are of certain kinds when we act in a certain way, his mental processes must be of this or that kind, when he acts in this or that manner. And we are forced to the conclusion, here as before, that the course or trend of conscious processes differs very considerably in different individuals. Similar stimuli have widely different effects: the series of mental processes set up by them,—so far as it can be inferred from actions,—may be altogether dissimilar. The beetle crossing your path is intensely interesting to you, if you are an entomologist, but may go unheeded, or even be an object of repugnance, if you are not. A blow which 'crushes' one man only serves to 'bring out' the character of another, who 'rises to the occasion.'

From observations of this kind we are led to classify minds under general headings. We are helped in two ways: we are constantly in the company of other people, and thus continually have thrust upon our notice the resemblances and differences which obtain between them and ourselves; and we are sorted out, during childhood, into classes which show how our mental constitution is regarded by parents and teachers,—into 'good' and 'naughty,' 'scatter-brained' and 'plodding,' 'ingenious'

and 'awkward.' So we come to think of minds as representing different types: we classify our neighbours and ourselves as dull or clever, sanguine or melancholy, ready-witted or absent-minded, and so on. Although our bodily tendencies never become conscious, — introspection cannot discover any specific tendency-process, — yet we find mental phenomena which may legitimately be brought into connection with those undisputed biological facts to which the name of 'tendencies' is given. In this way we are able, as psychologists, to assert the existence of tendencies, despite the impossibility of any direct experience of them.

To emphasise still further the fact that the tendency does not correspond to a specific conscious process, and that therefore we have no direct knowledge of it, let us suppose that there were but one man in the world, and he an enthusiastic botanist. He would never know that he had a leaning towards the study of plants. There would be no opportunity for a comparison of his pursuits with those of other men, which would teach him that 'botanic consciousness' and 'human consciousness' are not identical expressions. He could describe, by introspection, all his sensations and affections; but the existence of tendency would escape his notice altogether, because introspection would not reveal it.

In social life, on the other hand, where we can compare mind with mind, the manifestations of tendency are too evident to be overlooked. We know what various interests different people have; we know what radically different opinions two sane persons, the one 'emotionally' and the other 'rationally' minded, will draw from the same set of arguments; we know the 'professional attitude' of the lawyer and physician and clergyman to the questions of the day. There are thus ample materials from which the idea of tendency may be formed, and good reasons for its persistence when it has once taken shape.

We may summarise the results of this Section in two propositions. (1) Tendencies and the causes of tenden-

cies are in themselves phenomena which belong exclusively to the domain of physiology and biology. There is no tendency-process to be found in consciousness, co-ordinate with the processes of sensation and affection. (2) But a comparison of minds enables us to form an idea of mental types or constitutions; and having learned from biology of the existence of tendencies, we are able to point to these as the conditions of mental constitution, and thus to account for fundamental differences between mind and mind which we could not otherwise have explained.

It should be noted that the present is a signal instance of the way in which one science may render assistance to another in the solution of a difficult problem. If we had confined our discussion to the sphere of psychology pure and simple, and employed the introspective method only, we should have been obliged to give a mere statement of the facts of mental constitution, coupled with the admission that we had no explanation of them to offer. To avoid this necessity, we have asked what biology has to say of the influences exerted upon the organism by heredity and environment. By thus putting the individual mind in the perspective of mental evolution, we are able to dispose of the difficulty in a satisfactory way.

§ 36. **The Question of a Third Conscious Element.** — We have seen that the facts of mental constitution are so patent that they must be recognised and accounted for; but that introspection is, in the nature of things, incapable of furnishing the required explanation. Let us suppose, however, that a psychologist, confronted with the facts, does not think of going to biology for their reason, but attempts, in spite of all difficulties, to keep within the territory of psychology itself. If we follow out his argument we shall be able to understand a common view of the

nature of mind, — a view different from that which we have ourselves adopted (§ 3), but still so widely prevalent among educated persons as to seem, doubtless, to many readers, almost self-evident.

The psychologist of whom we are thinking will argue somewhat as follows. "We must, in every science, give the reason for what we observe. Now the reason for a sensation or an affection is obvious enough: it is always some observable change in the outside world or in consciousness, — the presentation of some stimulus or the arousal of some idea. But the reason for mental constitution cannot be found in the action of stimulus: the constitution is there, before the stimulus acts, — as is shown by the effect of the beetle upon the entomologist. Neither can it be found in any preceding conscious processes: it is the business of mental constitution to decide, as it were, what our mental processes are to be, — entomological ideas or the feeling of disgust. No! to give a reason for the direction or trend of consciousness as a whole, we must assume the existence of a permanent mind behind the stream of conscious processes. The manifestations of mental type are obvious; but we cannot explain them in terms of physical or mental process. Hence we must infer that consciousness is something active and directive, able to shape and mould its own processes, and to originate lines of thought or feeling."

It is not too much to say that belief in the activity or spontaneity of mind is almost universal; though the fact that the activity is, in the first place, not directly experienced as a conscious process, but inferred from the run or trend of conscious processes in general, is less universally recognised. And the belief is by no means confined

to popular thinking; it has had a marked influence upon psychology.

Since our supposed psychologist has gone beyond introspection, and has drawn inferences from the phenomena of consciousness to the existence of something behind consciousness which introspection does not reveal, he has been forced, in spite of his resolve, to leave the ground of psychology proper and to appeal for help to some science which is not psychology. The science to which he appeals is metaphysics (§ 3); our own appeal was made to biology.

Metaphysics is, as we have seen, the discipline which unifies and harmonises the principles and laws of all the other sciences. It follows from this that the discussions of metaphysics are always couched in general and abstract terms; and that it is wrong to appeal to it for an explanation of a single concrete fact. Just as, within the limits of psychology, we should not explain the appearance of a particular conscious process — an emotion of hope, *e.g.* — by appealing to mental constitution, and saying that the subject of the emotion was naturally sanguine, but should look round for the special conditions of this particular hope; so, within the limits of science at large, we may not explain the appearance of a single phenomenon — the phenomenon of mental constitution — by appealing to metaphysics. Mental constitution is one particular scientific fact, and the emotion of hope is another. Both must be scientifically explained, not metaphysically: both must be explained, that is, by a statement, in the terms of some special science, of the conditions under which they appear.[1]

Nevertheless, the metaphysical view is the common view. And the conviction of mankind at large, and its embodiment in current modes of expression, are usually strong enough to dominate our thought and language except on occasions of scientific investigation and discussion. The phrases which every one naturally

[1] Whether or not the inference of mental activity is justifiable from the *total sum* of mental phenomena is a question which we can attempt to answer only at the conclusion of our examination of mind. We shall recur to it, therefore, in our final chapter (Ch. XV).

uses in describing the phenomena of attention give a striking illustration of this fact. It is hardly possible to speak of attention without using such expressions as: "I turn my attention to," or "I direct my attention upon," — expressions which, if understood literally, would make the 'I' a source of spontaneous activity, and the 'attention' a sort of lantern which the 'I' holds in its hands.

Let us now follow the argument of our imaginary psychologist a little farther. "I am convinced," he may go on, "that there is a permanent mind behind the various types of mind, behind the varying manifestations of mind in conscious processes; and I am convinced that this mind is active and directive. Surely, this permanent and active mind must manifest its activity in some specific conscious process? Surely, there must be something other than sensations and affections to be found in mental experience? Introspection must decide: and introspection does decide — in the affirmative. I find two conscious processes which give me a direct experience of activity or spontaneity: conation and attention. My original inference, then, was plainly correct; it is confirmed by introspection. Not only must we infer from the facts of mind that mind is active; we have a direct experience of mental activity in certain well-marked conscious processes."

It is here that the belief in mental spontaneity begins to exert an influence upon scientific psychology. The argument has taken on a new character: the *venue* is changed. Mental activity is no longer a metaphysical inference from the facts of mind; it is announced as an item of mental experience. And it thus becomes the business of the psychologist carefully to examine the processes which are said to bear witness to its reality; for the acceptance or rejection of a third elementary conscious process — an

activity-process — is no light matter. The entire course of our subsequent psychological analysis, the fashion of our whole psychological system, will depend upon the decision to which our present enquiry leads.

It is important that the difference between inferred activity (metaphysical) and experienced activity (psychological) should be fully understood. We have refused to *infer* activity from the facts of mental constitution, because we thought it better, on principle, to appeal to other special sciences before we asked assistance from metaphysics, and because biology answered our appeal, and enabled us to give a reasonable explanation of the phenomena. But we cannot refuse to accept the verdict of introspection, if introspection says that there is a mental process of an 'active' quality, a mental experience which cannot be described except by the term 'activity' or 'spontaneity.' No sensation or affection has this 'active' quality.

And, physiologically, the existence of such a process is quite conceivable. Tendency may 'set' the cortex in a certain way, without arousing any conscious process; just as we 'set' an alarum-clock, without causing the bell to sound. But when the catch is released, the bell rings; and when the 'set' of the cortex is released, 'touched off' in some way or other, a new mental process may be originated. The alleged active quality does not correspond to tendency, but to the 'touch off' of tendency; not to the 'set' of the brain, but to the release of that set. It is not the fact of mental constitution which is becoming conscious when the new quality appears, but rather some specific realisation of mental constitution, say, the rush of an idea, aroused by external stimulus, into the channel which tendency has dug for it.

Our rejection of the activity-inference, then, need not impair our impartiality with regard to the suggested activity-experience. If we find this, we can very well give it a place, without changing our definition of mind and consciousness.

§ 37. **Conation.** — 'Conation' is the general name given to the experience of effort or endeavour, in whatever con-

nection it occurs. The 'conative consciousness' is a consciousness which consists principally, or at least very noticeably, of the experience of effort. What we have to do, then, is to collect instances of this experience, and to assure ourselves, by repeated analysis and reconstruction (§ 4), that it does or does not contain some specific conscious process other than sensation and affection.

The reason that the psychologist, who has inferred mental activity from the facts of mental constitution, points to the experience of effort as a confirmation of his inference, is this. Effort is always involved, to some extent, in our experience of bodily exertion, continued bodily movement. Now the causes of bodily movement are not seldom beyond the reach of introspection: while in many cases we can trace, by careful introspection, the reason for a movement, there are many other cases in which we cannot. We should ourselves explain the facts by saying that many of the unconscious bodily tendencies are tendencies to movement, and that therefore the reasons for certain movements must be asked from biology and not from psychology. Our imagined psychologist has just the same facts before him that we have, and is just as little able as we are to explain them by appeal to introspection. But he refuses to ask biology to assist him in the solution of a psychological problem; and therefore sees in movement, not a change in the organism due to physical causes, but an expression of spontaneous activity; and in the conscious experience of effort which accompanies movement, not a complex of sensations and affection, but a specific mental process, the quality of which corresponds to that spontaneous activity.

Or we may put the reason in another way. We speak not of the movements of our fellow-men, but of their 'actions.' Mental 'activity' is regarded as precisely like the 'activity' which the living human organism shows in its actions. Hence it is natural that the experience which accompanies action should be the first experience examined by those who expect to find evidence of mental activity in some definite conscious process.

The experience of effort occurs in many different connections. It always accompanies violent or long-continued bodily movement, the movements, *e.g.*, of fencing or of dumb-bell exercises. It is contained in the experience of resistance, as when we hold a door against some one who is trying to force his way into the room, or 'bear up' against some 'pressing' care. It appears also in the states of mind (the 'consciousnesses') which we call impulse, wish, desire, longing, aspiration; and in the experiences of 'trying to remember,' 'trying to make up one's mind,' etc. All these cases, then, must be introspectively examined.

The first thing which introspection reveals is that effort is, like idea, a compound conscious process. Whether it contains a specific quality — a new conscious element — or not, it certainly comprises sensations and affection. The affection may be pleasantness or unpleasantness, according to the degree or amount of effort involved in the particular experience. The sensations are sensations of strain (tendinous), and the sensations which accompany movement (sensations of cutaneous and articular pressure, and of muscular contraction).

No one will doubt that these sensations are present in the first three instances given of effort: fencing, dumb-bell exercise, holding a door. Their presence in the other experiences mentioned may seem to be less clear.

We must remember, however, that sensations may be aroused centrally (remembered or imagined) as well as peripherally (by the action of stimulus); and that they are just as much sensations in the former case as in the latter (§ 7). If, then, an actual movement and actual strain sensations can make up the experience of effort, so can also remembered or imagined movement and remembered or imagined strain sensations. Let the reader

analyse his consciousness when next he thinks: "I do *wish* it was dinner-time!" He will find that it contains a pleasantness, connected with the idea of dinner, and various ideas of himself going to his dinner, *i.e.*, making some bodily exertion. If the wish is very strong, however, he will find more than this: there will be real beginnings of movement in his body, a real beginning of rising from the chair, or a turn to the wash-stand, or a passing of the hand over the hair, — the imagined movements and imagined sensations will be mixed with actual movements and actual sensations aroused by them. Or again: suppose that one were painting a picture to illustrate the phrase: "I do long to go to Italy!" One would paint a figure seated in a chair, leaning forward with clasped hands, the eyes eagerly and intently fixed. That is, one would paint with the assurance that the speaker would be seeing Italy 'in the mind's eye,' picturing the journey, and — more than that — actually *starting* to go, *i.e.*, actually beginning the necessary movements. Here, too, we have imagined movement, central sensations of strain and pressure, mixed with actual sensations from muscle and tendon and joint. The forward inclination of the body and the eagerness of the eyes show that the ideas of the moment are pleasant. Once more: let the reader introspect when next he says: "If I only could remember that name!" He will find that his whole body has been braced, during the attempt to remember; that he has been frowning or wrinkling the forehead; that his eyes have wandered all round the room; perhaps, that he has from time to time held his breath and closed his eyes, to avoid any disturbance from outside. Along with all this has gone the unpleasant affection which comes with the feeling that he is baffled.

In every instance, then, we find in effort an affective quality and a complex of organic sensations, — largely, sensations of tendinous strain.

But, further, introspective analysis stops short at the discovery of these ingredients of effort. When we have taken the sensations and affection from the complex experience, there is nothing left: these are the only pro-

cesses which introspection can find in it. And if we test analysis by synthesis, and try to reconstruct effort from organic sensations and affection, we are led to the same result; these components are enough to give us the effort experience. Hence we have no alternative but to conclude that effort furnishes no evidence of a third conscious element, the supposed elementary process of activity.

It cannot be too strongly urged that our introspection must be absolutely impartial, and extremely careful. Since the supposed activity-process is, by hypothesis, neither sensation nor affection, and since the rules which we possess for the use of introspection apply only to the examination of those two processes, we must employ the method in both of its possible forms: it may be that the activity-process would more nearly resemble sensation, or it may be that it would be more like an affection. When we investigate effort as if it were sensation (§ 9), we come upon the complex of organic sensations referred to in the text; when we investigate it as if it were affection (§ 33), we come upon the affective quality which accompanies those sensations. Introspection gives no hint of any further process.

Introspection must decide the matter: it is the final court of appeal. But it is reassuring to find that the result of introspection is supported by outside evidence. This is of two kinds. (1) Those who believe in the existence of a specific activity-process often allude to it as a 'sensation of effort' or 'feeling of activity.' The expressions show that, even in their opinion, the experience of effort is a process which resembles the processes of sensation and affection. Why should it not be made up of these processes? (2) Intense effort is unpleasant, moderate effort pleasant, and minimal effort indifferent. This is just what we should expect if effort were composed of sensations: intense strain-sensations arise from excessive stimulation, and that is unpleasant; moderately strong sensations from moderate stimulation, which is exhilarating and pleasant, etc. (§ 34). Here is

evidence, from the general behaviour of sensations and affection, that effort is made up of those two processes.

§ 38. **The Nature and Forms of Attention.** — Effort is, however, not the only fact of mental experience which has been brought forward in support of the view that we have a specific conscious process corresponding to mental activity and spontaneity. This specific activity-process, which we have failed to discover in conation, is said to be present in attention, to be a constituent of the attentive consciousness. And at first sight the statement seems to be well founded. If ever we act spontaneously, it is surely when we lay down a novel to turn our attention to work; if ever we select for ourselves, it is when we ignore the whole crowd of impressions which our sense-organs are receiving, to attend to some one idea. In both these cases the activity-process must be present, if it exist at all. We must therefore examine attention, if possible, even more carefully than we have examined conation. If we cannot discover the activity experience here, we shall not discover it anywhere: attention is the only remaining fact to which the champions of activity can appeal, and it is a fact which, on the face of it, appears to furnish a strong confirmation of their view.

We have more than once had occasion to remark that the idea to which we attend is made clearer, and lasts longer than other ideas. It is difficult to imagine how life could go on, if there were no such thing as attention. We should be at the mercy of every stimulus, internal or external, which was strong enough to arouse a conscious process; sustained thought and continued occupation would be impossible; consciousness would be a mixed medley of sensations and affections, strung together as the accidents of stimulation determined. The reality is very different.

As I lean back in my chair to think out a psychological problem, I am subject to all sorts of sensory stimuli: the temperature of the room, the pressure of my clothes, the sight of various pieces of furniture, sounds from house and street, scents coming from carpet and wood-work, or borne in through the open window, etc. I could easily lapse into a reminiscent mood, letting these impressions suggest to me scenes from my past life. I could easily give the rein to my imagination, thinking of the further business of the day, anticipating some event which is to happen in the near future, etc. But I am perfectly well able to neglect all these distractions, and to devote myself entirely to the one centrally aroused idea, — the idea of the problem which awaits solution.

Attention has two forms. It may be what is called 'passive' or 'involuntary' attention, or it may be 'active' and 'voluntary' attention. We cannot understand its real nature until we understand how these two forms differ, and what are the reasons for their occurrence.

(1) *Passive Attention.* — There are many occasions when we 'cannot help' attending to an impression, — when a stimulus takes the attention by storm. A very loud sound will, almost infallibly, attract the attention, however absorbing the occupation of the time. So with movement: the animal or bird that crosses the landscape, the melody that rises and falls to a steady, uniform accompaniment (*i.e.*, that moves, while its accompaniment is stationary), the insect that crawls over our hand as we lie upon the grass, — all these constrain us to attend to them. Interesting things catch the attention, whether their interest come from their pleasantness or unpleasantness: a beautiful face arrests our eyes, as a matter of course, and the newspaper accounts of fires and murders have a 'morbid fascination' for us. Things which fit in with our present train of thought hold the attention: if

we are feeling ourselves ill used, we notice a thousand little annoyances that we should otherwise have let pass unnoticed, — if we are trying to prove a scientific theory, facts offer themselves to our attention whose significance we should otherwise have missed. Contrast, like movement, draws the attention: the one tree on a level plain, the one civilian's dress among a mass of military uniforms. So with strange things in familiar settings, and familiar things in strange settings: a new picture upon our study wall obtrudes itself upon us, and a few words of English, heard amid a crowd of holiday-making Germans, force our attention irresistibly upon the speaker.

Any one of these conditions — contrast or movement; a high intensity, novel quality, etc., of sensation; the 'interest' attaching to an impression; a close relation of the idea aroused by the impression to the ideas forming the consciousness of the moment — is able to give a definite direction to the attention; an object which fulfils any one of them has the power of attracting the attention to itself. The attention is passive: we have to attend, whatever grounds we may have for attending to something else.

(2) *Active Attention.* — There are, however, many occasions when, so far from the idea's drawing and riveting our attention, it seems that we are holding our attention by main force upon the idea. A problem in geometry does not appeal to us as a thunder-clap does. The thunder-clap takes unquestioned possession of consciousness. The problem has only a divided claim upon the attention: there is a constant temptation to wander away from it and attend to something else. Only gradually, as we grow interested and 'absorbed,' — as the active atten-

tion becomes passive, — does it gain that forcible hold over us which the thunder-clap has from the moment of its appearance in consciousness. In many of the psychological experiments which we have described, the object of attention is something which of itself, so far from attracting notice, would be eminently fitted to escape it: an obscure organic sensation, a minute qualitative difference, etc. Attention to such an object is active attention.

Let us see, now, how the psychologist who finds in attention the specific activity-process, the experience of mental spontaneity, regards these two forms of the attentive consciousness. "Both kinds of attention are alike," he will tell us, "in the fact that they involve a change in our ideas. The idea attended to becomes the clearest, strongest and most permanent idea in consciousness. But the two kinds differ in this: that the change in ideas is brought about in the one case (passive attention) by the nature of the stimulus, while in the other case (active attention) it is the result of the mind's own activity, — the mind is moulding its ideas for its own purposes. There is clear evidence of the difference in the two experiences; in passive attention we have the action of stimulus and the resulting change of ideas, — and nothing more; in active attention the mind's activity shows itself in a definite mental process, an active process, which accompanies the change of ideas. Every one who has ever been actively attentive must be aware that he has experienced this definite process, of active quality."

Here, then, are two facts for us to examine: the change of ideas, and the alleged activity-process. We will take the latter first.

(1) *The Alleged Experience of Activity, in Active Attention.* — If we try to ascertain, by the aid of introspection, the processes of which the attentive consciousness is composed, we come at once upon a mass of organic sensations combined with affection into a total which very nearly resembles the conation of the previous Section. There is a brace of the whole body; the muscles are tense, ready for movement. More especially is there muscular tension in and about the head. If the object of attention is visual, the eyes are fixed steadily upon it, the eyebrows lowered, the scalp muscles tightened, the head settled squarely back upon the shoulders. If its object is auditory, the head is turned toward one side and thrust forward, the muscles which move the drum of the ear drawn taut, etc. In both instances the breath will be held, from time to time. All this means a complex of sensations from skin, muscle, sinew and joint, and an accompanying affection. It means an experience of *effort;* and the only difference between this effort and the effort of the last Section is that this is, as a general rule, a more localised effort, whose components are not spread over the whole body in equal degree, but are centred round some particular sense-organ, eye or ear, etc. It is an effort which involves, not so much an adjustment of the whole muscular system, for locomotion, as an adjustment of a special organ for the best reception of stimulus. But it is none the less a form of conation, and may rightly be termed effort.

And, again, introspection stops short at this point. When we have taken the sensations and affections from the 'activity experience,' there is nothing left. There is no evidence of the third conscious process, however

often we may analyse and reconstruct in our search for it.

More than this: introspection does not show any radical difference between active and passive attention. In passive attention, too, we find muscular adjustment; the turn of the head, the brace of the body, the fixing of the gaze, etc. True, the effort is not so great as it is in active attention; but effort is undoubtedly present. It is less, because there is only one idea to be attended to, whereas in active attention several ideas are claimants for the attention.

To sum up: There is only one attention, not two. The differences between passive and active attention are differences of 'degree' (*number* of ideas, *amount* of effort), not of 'kind.' The terms 'passive' and 'active' are misnomers. In passive attention, one idea takes unresisted possession of consciousness; in active attention, there is a conflict of ideas for the favours of the attention. In the latter case, the experience of effort is pronounced and well marked; in the former it is present, but less strong. These are the only differences between the two forms of attention.

(1) *Passive Attention.*—The reasons why certain things or attributes of things compel the attention, while others are left unnoticed, are, in the last resort, biological reasons. Some of them are of a general nature, applying to all living organisms alike. The animal which is to survive *must* attend to movement, contrast, very intensive impressions, etc. Hence we all attend to these; attention to them is ingrained in our nervous constitution. It is a more special reason, of course, which accounts for the entomologist's attention to the beetle. Here we have a particular animal with particular tendencies; tendencies in the first place natural, and now confirmed by education and habit.

(2) *Active Attention.*—The reasons for the phenomena of active attention are also, in the last resort, biological. As soon as an organism comes to have a system of sense-organs, each with its

peculiar attachment to the central nervous system, there must necessarily be times when its attention is called simultaneously by two different stimuli, — say, by a visual movement in front of it, and by a loud sound at its side. On the occurrence of this twofold stimulation, the attention will travel in quick succession from source of movement to source of sound, and *vice versa*. (Whether it go first to the one or to the other will depend upon circumstances, — upon the attitude, physical and mental, of the moment; upon the organism's previous experience; upon the relative development of eye and ear; upon the objective clearness of the two stimuli, etc.) The effort must plainly be greater than in the case of attention to either stimulus alone; there is more bodily movement, adjustment of organs, etc., required.

The more complex the organism becomes, the more frequently must it happen that stimuli are simultaneously presented, which cannot be attended to in this see-saw way, though both have strong claims upon the attention. Suppose, *e.g.*, that I am sitting in my room, preparing for to-morrow's examination, and that I hear an alarm of fire in a neighbouring street. I cannot run from work to window, and from window to work, in quick succession; if the work is to be done, the attention to it must be sustained. In a case like this, one claimant must give way to the other; there is a real conflict. The cortex is 'set' in one part for work; and this setting is reinforced by a large number of excitations, — the processes corresponding to ideas of my examination mark, the consequences of failure, etc. The cortex is 'set' in another part for looking at the fire; and this setting is reinforced by other excitations, — the processes corresponding to the ideas of a run in the fresh air, an exciting scene, the meeting with friends, etc. Which side wins depends upon the strength of the tendencies and of their temporary auxiliaries. Again, the effort experience must plainly be more distinct than in the case of attention to either stimulus alone.

Additional ground for thinking that there is no radical difference between passive and active attention is to be found in the fact that what begins as active attention may quite well end as passive. If we once 'settle down' to our work, we may grow so 'sunk' and 'absorbed' in it that the fire-bell passes unnoticed.

This fact can hardly be explained by those who assume the presence of the activity-process in active attention; for why should that process disappear, as attention is continued?

It may be remarked here that the reduction of active to passive attention is the condition of all thorough intellectual work. The passive attention of the animal or the child is the first stage of attentional development. Then comes the active attention, during which the mind is held by a certain stimulus, but held in face of opposition from other stimuli. Finally, this stimulus gains an unquestioned ascendency over its rivals, and the attention is once more passive. The stage of active attention is itself a stage of transition, of conflict, of waste of mental energy; but it is the necessary preliminary to a stage of achievement.

(2) *The Change of Ideas in Attention.* — Whenever we attend to an idea, certain changes are brought about in that idea and in the other ideas of the time. (*a*) The idea attended to becomes clearer and more distinct. If I am listening to a four-part chorus, and suddenly give my full attention to the tenors, the tenor part stands out distinctly from the whole mass of sound. It does not become stronger, louder; but its tone qualities are detached from the tone qualities of the other parts. (*b*) Sometimes, however, the idea attended to does increase in intensity. A very faint light grows noticeably brighter, as we attend to it; a very faint sound, noticeably louder. (*c*) The other ideas of which consciousness is composed are rendered less distinct and, apparently, weaker than they previously were. As we listen to the tenor part, the three other parts blur, and fade out.

The activity-theory explained these three facts as the effects of mental activity; the mind, of its own accord, assisted some ideas and repressed others. We have been unable to find an activity-process, and have accounted for the manifestations of attention in

general by emphasising the natural 'selectiveness' (§ 35) of the nervous system, the presence of organic tendencies. We have now to ask for the special physiological conditions of these three manifestations of attention. They appear both in passive and active attention.

Physiologists have discovered that one nerve-cell can influence another in two different ways. It can inhibit or check the processes going on in the other, or it can facilitate or reinforce them. During attention, both of these influences appear to be at work. There is facilitation or reinforcement of cerebral function on the one hand (the idea attended to becomes clearer or stronger); there is widespread inhibition of cerebral function on the other hand (the remaining ideas grow dim and weak).

It is natural to look for the origin of the reinforcing and inhibitory processes in the association centres, the supreme co-ordinating centres of the brain. Physiology supports this hypothesis, but does not furnish us with any detailed explanation. It may be that, as the cortex at a given moment represents a certain limited sum of physical energy, the determination of the currents of excitation to a particular sense area, in sufficient force to bring the neighbouring association centres into play, necessarily drains the rest of the cortical areas of their energy; so that function at the point of excitation is enhanced, and function elsewhere depressed. This theory, however, makes facilitation a positive and inhibition a merely negative, passive, matter; and we have every reason to regard inhibition also as positive. We must confess to ignorance of the precise mode in which the two influences are exerted; but there can be no question that they exist.

We have seen that the bodily conditions of *affection* probably include the action of an association centre, and that there is a close psychological connection between affection and attention (§ 32). We find, as a matter of fact, that it is *only* when we attend to impressions that we feel them to be pleasant or unpleasant. Impressions which are not attended to are indifferent. If we can 'forget' our toothache, *i.e.*, find something more interesting and absorbing and so cease to attend to the tooth, the unpleasantness vanishes.

Impressions which have grown habitual, *i.e.*, whose affective attribute has worn off, are impressions which have ceased to attract the attention. Hence, when we say that an 'interesting' thing catches the attention, we are really speaking tautologically. A thing is 'interesting' when it is 'a thing to be attended to.' It is not that the pleasantness or unpleasantness comes first, and that we then attend to the impression: the two parts of our experience, the affective and the attentive, are simultaneous. In popular parlance, we attend because the thing is interesting; in psychological language, the interest and the attention are two sides of the same experience.

Putting the physiological and psychological together, we may say that attention to a pleasant theme corresponds to an exercise of function by a well-nourished association centre, and attention to an unpleasant theme, to the exercise of function by an ill-nourished association centre. Since attention is always attention to something, there must also be an excitation set up in some sensory cortical centre (visual, auditory, etc.); and in the same way, any pleasantness or unpleasantness implies the excitation of the cortical centre, to which the pleasant or unpleasant idea belongs. And just as it is one effect of the adjustment or adaptation of the nervous system that its surroundings are indifferent, and the nourishment of the highest centres unaffected by them, so it is another result of adaptation that the organism gradually ceases to attend to frequently repeated impressions, and that the highest centres are not called upon to perform their functions, — the lower brain centres meeting all the requirements of the occasion. Lastly, we now see the special reason for the impossibility of attending to an affection (p. 108). Attention and affection are two sides of one and the same process.

The results of this Section may be summarised as follows. *Attention* to an impression means three things. It means (1) that consciousness is conative, *i.e.*, made up in large part of the complex experience of effort; (2) that a particular idea or perception, or small group of ideas or

perceptions, becomes clearer, more lasting and (perhaps) stronger than it was before; and (3) that the remaining processes which go to make up the consciousness of the moment become fainter, more transient and less distinct than they otherwise would be. On the physiological side we have: (1) a tension or set of the muscles, extending more or less widely over the whole body, but especially well marked in some particular organ (*cf.* the attitude of the eavesdropper, or the set of the eyes, wrinkling of the forehead, etc., in attentive thinking); (2) central reinforcement or facilitation of particular excitations; and (3) central inhibition of other excitatory processes.

There is no trace in attention of a third elementary conscious process, co-ordinate with sensation and affection.

§ 39. **The Attributes of Attention.** — It is evident that we cannot speak of 'attributes' of attention in precisely the same sense in which we have spoken of the attributes of sensation and affection. Attention is not a simple, elemental process: it is a *complex* of elementary processes (the sensations and affection which make up the experience of effort) accompanied by changes (changes of intensity, distinctness, duration, etc.) in other mental processes. Nevertheless we can look at attention, as we can at sensation, from different points of view. It will be well, therefore, to ask whether the differences which it presents in any way resemble the differences of quality, intensity, etc., which exist between sensations and affections.

(1) To speak of the *quality* of attention would be meaningless. The qualities present in attention are (*a*) the sensation qualities contained in the experience of effort, qualities of strain, etc., — whether peripheral (coming

from actual bodily adjustment) or central (coming from remembrance or imagination of bodily adjustment); (*b*) an affective quality, pleasantness or unpleasantness; and (*c*) the quality (or qualities) of the sensation (or perception or idea) attended to. Although the quality of strain is always present, it need not be the predominant quality in attention: the predominant quality may be that of the sensation or idea attended to. And as any sensation or idea may be attended to, there cannot be any specific or characteristic 'attention quality.'

(2) We might attribute *intensity* to attention, meaning by it the effectiveness with which the object of attention (the idea attended to) is reinforced, and the remaining conscious processes inhibited, in a given case. That differences of this kind exist is obvious. We may be completely absorbed in a subject (very high degree of reinforcement, with very effective inhibition), fairly attentive (high degree of reinforcement, less effective inhibition), little attentive (little reinforcement, weak inhibition), or entirely inattentive (no reinforcement and no inhibition). But as intensity is here used in a new sense, to mean the intensity of a total complex process, and not of one of its simple components, it will be better to avoid the term, and to speak rather of the *degree* of attention.

(3) Attention cannot be maintained for an indefinite length of time; it 'tires' or 'relaxes.' Moreover, it varies greatly in *duration*, shifting from object to object at irregular intervals, altogether irrespectively of fatigue. We may attend to a lecture, without tiring, for a whole hour; but we may also attend for a few seconds only. We must enquire, then, for how long a time the reinforcing and inhibitory processes can co-operate, without

relaxation, *i.e.*, what is the maximal duration of attention to one object; and try to ascertain the reasons for relaxation, when it appears.

(4) Attention has no *extent*, in the sense in which visual and tactual (cutaneous and articular) sensations have extent. But it has a different *range* in different cases: we may attend to a single sensation of red, or to a watercolour drawing which shows all the colours of the spectrum. The question of the maximal range of attention thus arises: the question, *i.e.*, to how many impressions we can attend, without slurring over any one of them.

We previously noticed the fact that it is possible to speak of the intensity, duration, etc., of complex as well as of simple conscious processes (§ 8). Attention offers an instance of this usage.

§ 40. **The Degree of Attention.**—We can say nothing very definitely of the different degrees of attention. Language makes certain rough distinctions: 'close' or 'rapt' or 'absorbed' attention is opposed to 'wandering' or 'fitful' attention or to inattention, 'complete' attention to 'divided' attention, etc. But these phrases give us no better idea of the number of possible attention degrees than do the expressions 'light grey,' 'grey,' 'dark grey,' of the number of distinguishable qualities of brightness sensation.

Since attention always includes the effort experience, it might be thought that the intensity of effort would furnish a measure of the degree of attention. But a little consideration shows that intensity of effort and degree of attention do not run parallel to each other. We very easily become absorbed in our favourite topic (high degree

of attention, containing but slight effort); while a small amount of attention bestowed upon an uninteresting subject renders the effort-complex exceedingly prominent in consciousness.

The reason is, that effort is only a part, not the whole, of attention. It does not follow that because effort is strong or weak the whole process of attention must be strong or weak. The experience of effort is one side of attention; the changes in the idea attended to, by reinforcement, and in other ideas, by inhibition, are the other side. If the processes of reinforcement and inhibition are materially aided by tendency, by the 'set' of the cortex, we may get great attention (total conscious process) with but little effort (part-process); if they are not, we may have a considerable effort and yet but scant attention.

Thus we may listen to a tedious speaker — because it is 'good manners' to listen — while our attention is more than half taken up with our own thoughts. Here the amount of effort (part-process) experienced is by no means proportional to the amount of attention (total process) given. A certain acquired tendency is reinforcing the excitations which correspond to the ideas of social propriety, respect for age, etc., while natural tendencies are reinforcing other excitations which correspond to the subject of our thoughts. There is a conflict (§ 38), and the former wins; but wins by a narrow margin. Hence a high degree of effort occurs in conjunction with slight reinforcement of the speaker's words and slight inhibition of the listener's thoughts: a weak attention includes a strong effort.

On the other hand, the 'born' naturalist follows the line of least resistance when he stops his conversation to watch the manœuvres of a spider on the window-pane. A natural tendency has 'prepared' the cortex for the reinforcement of the excitations corresponding to the perception of the spider, and the inhibition of other excitations. Here, there is a strong attention, including but a slight effort.

The term 'inattention' is used in two senses. Strictly defined, it is the lowest degree of attention. In this significance, it is the obverse of extreme attention: absorption in one topic means inattention to all others. In its secondary sense, inattention is used to denote a fact of mental constitution as a whole, and indicates a low stage of mental development.

(1) Those who are capable of sustained attention, and whose occupations give constant exercise to this capacity, are rarely inattentive (to one thing) unless they are closely attentive (to another). We have the extreme form of inattention (and of attention) in absent-mindedness or 'brown study.' Here the attention is so exclusively concentrated upon a congenial topic that all impressions which are not connected with it pass unattended to.

(2) Animals are 'constitutionally' inattentive, in the second sense of the word. Although the organism is 'selective' (§ 35), *i.e.*, has definite tendencies, there is no conscious co-ordination of these tendencies for a scheme or plan of life. In the most highly developed mind, on the other hand, — the mind of civilised man, — the natural tendencies are pressed, during education, into the service of some life-plan. We may express the difference metaphorically by saying that in ourselves the tendencies are focussed upon some definite object, or that the attention is trained in some one direction; whereas, in the animal, tendencies subsist side by side, and are focussed or converged upon a particular object only at the instigation of sheer necessity, and only for so long as the necessity lasts. Or again: we have a conscious end (ambition, ideal, etc.) before us; the animal has none.

There are, however, many members of civilised communities who are thus 'constitutionally inattentive,' *i.e.*, who are incapable of sustained attention, whose attention is caught by anything and everything, and relaxed as lightly as it is caught. We term them 'scatter-brained,' 'unreliable,' 'forgetful,' 'capricious,' 'uncertain,' 'changeable,' etc., according to the circumstances in which their constitutional lack of attention is manifested. The mental type is

illustrated more often in children than in adults, — indeed, it is natural to children at a certain stage of mental development, — and more often in women than in men.

Mental pathology gives us an extreme instance of this constitutional inattention in the *dream* consciousness, and an instance of exclusive concentration in the *hypnotic* consciousness. Unfortunately, both dreaming and hypnosis present conditions which are unfavourable to introspection.

§ 41. **The Duration of Attention.** — We can attend to the same topic for a considerable length of time. Music lovers will sit out a five hours' opera without letting their attention wander from the music; and there are many things — an interesting public ceremony, a baffling mechanical puzzle, the last work of a popular author, a newly invented machine — which will hold the attention for a long time. Hence we might be tempted to suppose that attention is a relatively permanent state of consciousness.

But if we look closely at experiences of the kind, we see that the object of attention is, in reality, constantly changing. The musical themes vary, the ceremony proceeds, the puzzle is tried now in one way and now in another, the plot of the story developes, the machine becomes intelligible part by part. Attention, in each instance, is attention not to a single impression, but to a series of different impressions. Consequently, the experiences tell us nothing of the duration of 'an' attention, if the phrase be permissible, — of a single attentive consciousness.

The question can be answered only by an appeal to experiment. For it is only under experimental conditions that we can keep the object of attention absolutely simple, and so far rule out disturbing influences. Many experiments have been made, and all have led to the same

result: that attention is not persistent, but intermittent, — rising and falling, waxing and waning, at quite short intervals. If we attend as closely as we can to a simple sense-impression, its quality is not made permanently clearer and more distinct; it becomes alternately clear and blurred, distinct and indistinct. The attention fluctuates.

The fluctuations of attention are usually irregular. The time of a single 'pulse' of the attention — from distinctness to distinctness, or from indistinctness to indistinctness of the impression — has been found to vary, in the case of weak stimuli, between the limits of 6 and 24 sec.

Method. — It is best to work with the weakest possible, *i.e.*, with just noticeable stimuli. For if any blurring or indistinctness occurs in a sensation which, at its best, is only just noticeable, it is plain that the sensation will disappear altogether. Waxing and waning of the attention will then mean appearance and disappearance of the sensation; and it is far easier to say that we do or do not see or hear something than to say that what we see or hear has grown more or less clear or distinct.

Paint a very light grey circle upon a square of white cardboard, and place the card so far from the eye that the grey is only just distinguishable, only just noticeably different from the white. Look steadily at the circle. It will be visible for a few moments; then the white of the card will seem to wash over it; then it will appear again; then disappear, and so on. Let an assistant hold a stop-watch. Each time that the grey becomes clear, tap the table with a pencil: the assistant will note and record the intervals between tap and tap. When you have accustomed yourself to the experiment, you may tap the table not only when the grey appears, but also when it disappears, and compare the length of time during which attention is sustained with the length of time during which it is relaxed. The former time will probably be the longer.

The experiment may be repeated with a faint noise as stimulus — say, the tick of a watch removed so far from the ear that its sound is only just audible. In this case you must signal to the assistant by some different means, as the tap on the table would interfere with your attention to the watch. You might, *e.g.*, have a string attached to your forefinger and to his wrist, and pull upon it when the ticking appeared and disappeared.

Since you are working with minimal stimuli, you must be careful to have the sense-organ exactly adjusted to the impression. A chance movement of the eye or a slight turn of the head would cause the grey circle or the watch-tick to disappear, quite independently of the attention. The duration of the attention can be inferred only from the behaviour of the sensation under absolutely constant bodily conditions.

It is to be noted that attention to centrally aroused sensations — *e.g.*, an imagined watch-tick — is subject to the same fluctuations as attention to external stimuli.

The explanation of the intermittence of attention is to be sought in the nature of the physiological processes (processes of cortical reinforcement and inhibition) which correspond to it. When a nerve-cell acts upon another nerve-cell, it does this not gradually or continuously, as if influence 'flowed' from it, but suddenly and at once, as if the influence were 'discharged.' Indeed, physiologists speak always of the 'discharge' or 'explosion' of a nerve-cell, when they refer to its exercise of function. We must imagine, therefore, that when the association centres reinforce or inhibit an excitation, they act by jerks: there is a jet or spurt of energy from them, — then a brief pause, during which they recuperate, lay up more energy, — then another jet, and so on. In the pauses between jet and jet, the cortex is at the mercy of other impressions than that which is the special object of attention: there is a relaxation of the attention, and the ideas correspond-

ing to these other impressions take the place of the idea attended to.

'But whence do these impressions come? We are working under experimental conditions, and have ruled disturbances out.' We have ruled out disturbances, so far as we can. But we cannot rule out the rustling of our clothes which comes with the rise and fall of the chest in breathing, the noise of heart-beat, the pressure from the twitching of a muscle, the tickling of a hair, the tingling of the skin, etc. Still less can we rule out disturbing central excitations. Memories and imaginings of all sorts start up, — the counterparts of some chance excitation in a cortical centre, — and the attention is diverted from the given impression before we know that there is anything present to divert it.

The great importance of these distracting impressions is vouched for by introspection. Attend to the grey circle or watch-tick as before; but interrupt the experiment, as soon as the impression has disappeared, to ask yourself introspectively the reason for its disappearance. It may have vanished because your eye 'slipped,' or your collar creaked. In that case try again. You will find that the impression disappears, however favourable the conditions for seeing or hearing; and that it disappears when the attention has been distracted by the 'cropping up' of some irrelevant idea.

Introspection cannot, however, show why it is that the irrelevant ideas are allowed to crop up. The reason for that lies in the nature of the physiological processes which constitute the condition of attention.

It is natural to suppose that, if we could secure really constant conditions of experimentation, internal and external, we should find the fluctuation of attention to be regular. Under such conditions, discharge and reloading of frontal lobe cells should succeed each other with perfect regularity. The conditions are, unfortunately, almost impossible of realisation, — impossible, un-

less a happy chance assist our efforts to regulate circumstances. It has been found, however, in experiments made with all conceivable caution, that the fluctuations may be regular; in these experiments, the time occupied by a single pulse of the attention was 3.5 sec.[1]

This result agrees with a fact of general psychological experience: that the *signal* for any experiment is best given to the observer some 1.5 to 2 sec. before the experiment is made. The interval allows the attention to come to its full strain, but ends before relaxation has begun. It is surely significant that it is just half of the fluctuation-time mentioned above.

§ 42. **The Range of Attention.** — Our problem is to determine how many impressions can be attended to together, without diminution of the clearness, intensity, etc., to which each one of them would attain if the attention were directed to it singly. It is a common saying that 'nobody can attend to two things at once'; but experiment shows that the truth of the statement depends upon what the 'things' are, whether complex or simple impressions; and, if they are complex, upon the degree of their complexity.

We can approach the problem in two ways, — by a simultaneous and a successive method. We may present a number of stimuli to a sense-organ at the same time, gradually adding to them, until it becomes impossible to attend to all at once. This procedure is the best for

[1] It may seem strange that while the average pulse of the attention lasts from 6 to 24 sec., pulses so short as 3.5 sec. should be obtained under the most favourable circumstances. It is probable that the pulse is of different duration in the case of different individuals. It may be, however, that the results which give 6 to 24 sec. are not wholly trustworthy; that the stimulus was not minimal throughout the experiments, and that accordingly one or more blurrings or fadings of the impression were overlooked by the observers. New investigations must be made, before the question can be finally settled.

visual and cutaneous stimuli (lines, letters, circles, bands of colour, etc., laid upon the same background; or simultaneous pressures at different parts of the body). Or we may give the stimuli in succession, gradually increasing their number till the point is reached at which the first disappears from consciousness as the last is given. This method answers best with auditory stimuli (*e.g.*, beats of a metronome). In both cases the object of enquiry is the same: we wish to determine the limit of complexity at which the attention becomes unable to cope with the stimuli offered to a given sense-organ.

It has been found by the former method that four or five simple visual stimuli can be presented together, without distraction of the attention from any one, *i.e.*, without diminution of its clearness, intensity, etc.; while the second method leads to the conclusion that a series of eight auditory impressions can just be grasped by the attention.

Method: (1) *Simultaneous stimuli.*—Prepare a series of white cards, upon which are printed letters, lines, etc., in gradually increasing numbers. One of the cards must be set up, in each experiment, at a convenient distance from the eye of the observer. In front of it is an apparatus resembling the instantaneous shutter of a photographic camera. When this apparatus is set in action, the card becomes visible for a fraction of a second. The time of exposure must be very short, since otherwise the eye may sweep rapidly over the impressions, leaving some to be remembered while the others are directly attended to: in this case they would not be apprehended by 'an' attention, but by a series of attentions. The card, too, must be so small as to be easily 'taken in' by the eye at a glance, without eye-movement. Otherwise we may be measuring not the extent of the 'field' of attention, but that of the field of vision. Thus, if the field of vision were filled

out with broad bands of colour, we might reach its limits before we had reached the limits of the grasp of the attention; three bands, of red, green and blue, might fill the visual field, while the attention, as we have said, is able to grasp four or five simultaneously presented simple visual impressions, — colours, letters, lines, etc.

If letters are employed as stimuli, they must form a meaningless series, such as RKZT. It has been found that a familiar word of four letters can be apprehended by the attention as if it were a single letter; it is attended to, not as a series of letters, but as one total impression (Ch. VII). For the same reason, the attention can deal better with figures than with disconnected letters. Any combination of figures 'makes sense,' represents a definite number: 4321 means something, just as much as 1234.

(2) *Successive Stimuli.* — The running weight upon the tongue of a metronome is so placed that the interval between beat and beat is about a quarter of a second. The experimenter marks off groups of beats by sounding a bell simultaneously with the first beat of each group. Two series are given in each experiment: thus, $\left.\begin{matrix}\text{bell}\\ \text{beat}\end{matrix}\right\}$ — beat — beat — beat; $\left.\begin{matrix}\text{bell}\\ \text{beat}\end{matrix}\right\}$ — beat — beat — beat; and the observer is required to say whether the two groups are equal or unequal. He must not count, of course; counting would mean that attention was given to each beat separately, and, therefore, that the series was apprehended by successive attentions, and not by 'an' attention. Accurate judgment is impossible in the case of series which consist of more than eight impressions.

But just as in the previous experiments a word of four letters was equivalent, for the attention, to a single letter, so here a group of impressions may be equivalent, for the attention, to a single impression. We have already referred to the influence of rhythm in judgments passed upon the relations of auditory stimuli (§ 29). Now when we listen to our series of metronome beats, it is impossible to avoid throwing them into a more or less complex rhythm. If the 8 impressions which constitute an experimental series are single beats, they are apprehended not as 8 but as 4 (*beat* beat, *beat* beat, *beat* beat, *beat* beat; not beat, beat, beat, beat, beat,

beat, beat, beat) ; so that, for the attention, they *are* 4 impressions. The limits of the grasp of attention lie between 8 impressions of 2 beats each (16 beats in all) and 5 impressions of 8 beats each (40 in all). The 8 beats in the latter case are broken up into 4 pairs, accented as trochees (*cf.* § 47).

The range of affection we found to be coextensive with consciousness. It should be possible to say the same thing of the range of attention, if affection and attention are simply obverse and reverse of a single process (p. 143). Yet the range of attention, as defined in this Section, is evidently much less than the range of a full consciousness. The reason for this apparent anomaly is the two-fold meaning of the phrase 'range of attention.' By range of attention, as used here, we mean the number of ideas that become *clearer* during the total attentive process. But when we compare the range of attention with the range of affection, we must include under the term attention not only the ideas that are made *clear*, but the ideas that become *less clear:* attention consists of reinforcement of certain ideas and inhibition of others. In this sense, as covering both the ideas emphasised and the ideas slurred, attention is coextensive with consciousness.

Our estimation of the *simultaneity* (p. 144) of two or more impressions is not always accurate. Stimuli given at different times may yet fall within the range of attention at what appears to the subject to be the same time.

Method. — Experiments must be made by aid of an instrument called the 'complication pendulum.' This gives (1) a continuous series of visual impressions: a black pointer travels round a white clock-face; (2) a series of bell-clangs; (3) a series of electric shocks at some part of the body; and (4) a series of sharp noises. Two, three, or all four series can be employed. If (1) and (2) are used, it is found that when the attention is directed more strongly to the clock-face, the bell is heard too late: a position of the index and a clang are thought to occur simultaneously when, as a matter of fact, the clang is the earlier of the two impressions; while, on the other hand, when the attention is concentrated upon

the sound, the index is seen too late: a sight and a sound are thought to occur simultaneously when, as a matter of fact, the clang is the later of the two impressions. — The experiments are so difficult, and have been made in such small numbers, that no numerical time-results can be given. They show, however, that the sensation attended to not only increases in clearness and duration (p. 144), but also enters consciousness more quickly, than the sensation whose stimulus receives a smaller measure of attention.

References for Further Reading

Ebbinghaus, *Grundzüge*, I, §§ 55-59.
James, *Principles*, I, iv, xi; II, xxvii.
Külpe, *Outlines*, §§ 40, 72-76, 78.
Wundt, *Grundzüge*, ii, xv, xvi (§ 4), xix (§§ 2, 3).
Consult also: S. Exner, *Entwurf zu einer physiologischen Erklärung der psychischen Erscheinungen*, I, 1894; Th. Flournoy, in *L'année psychologique*, 1895; A. J. Hamlin, in *Amer. Journ. of Psych.*, 1896; A. Moll, *Hypnotism*, 1898; Th. Ribot, *Psychologie de l'attention*, 1889 (a valuable monograph, which, however, exaggerates the importance of the 'motor' side of attention: p. 138 *supra*); W. Weygandt, *Entstehung d. Träume*, 1893.

PART II

CHAPTER VII

Perception and Idea

§ 43. **Sensation, Perception and Idea.** — We have hitherto used the terms 'perception' and 'idea' indifferently, to signify a complex of sensations; and we have implied that such a complex process becomes, under certain conditions, a single item of mental experience, forms a coherent whole, — so that we can speak of its intensity, duration, etc., quite apart from the intensity or duration of the elementary processes which enter into it. We must now ask how these complexes are formed; which of the four attributes of sensation are of the greatest importance for their production; and under what circumstances they acquire their unity or singleness for mental experience.

There is no fundamental psychological difference between the perception and the idea. It is customary to speak of 'perception' when the majority of the simple processes in the complex are the result of stimulation of a sense-organ, *i.e.*, are peripherally aroused, and of 'idea' when the greater number are the result of an excitation within the brain cortex, *i.e.*, are centrally aroused. If I have a table before me, and my eyes are open, I am said to 'perceive' the table; if I close my eyes, and think of what I saw, to have an 'idea' of the table. But we have seen that the sensations aroused centrally do not differ as psychological processes from those aroused peripherally (§ 7); and this remains true, even if, as the most recent brain-physiology teaches, the two sorts of sensations have their seats in different parts of the cerebral cortex. Hence although we might be tempted for convenience' sake to follow the common usage, — to employ 'perception' to denote what is now before us, and

'idea' to denote what is remembered or imagined,—we should be obliged constantly to remind ourselves that, in principle, the two processes are one and the same. And the danger of forgetting this would far outweigh, in psychology, the convenience of separating the terms. In natural science, on the other hand, and in practical life, the distinction is very necessary.—In what follows, therefore, as in what has preceded, we shall use the words indiscriminately.

We classified sensations in the first place by reference to the sense-organs from which they proceed, and secondarily by reference to the stimuli which arouse them. We might now classify ideas in the same way, beginning with the great groups originated in a sense department (visual, auditory, olfactory, etc.), and subdividing these by the help of differences of stimulation within a department (ideas of colour, of brightness, of tone, of noise, etc.). But such a classification would be misleading. The sense-organs are, as a matter of fact, not separate instruments: they are instruments in the service of a single organism, and they are connected with one another, by way of the brain. So long as we are enquiring into the nature and number of the elementary conscious processes (§ 4), we may regard each group of sensations as separate and independent, and each member of a group as an individual process, possessed of its own attributes. But when we come to consider sensations as elements in ideas, we find, naturally enough, but little show of independence and individuality. The particular sensation, regarded apart from other sensations, is the product of scientific analysis, an abstraction from actual mental experience: the simplest item of that experience is the idea. It was necessary for us, as psychologists, to see how the sense-organs would work if they were working separately. That done, how-

ever, we must go on to enquire how they really do work together for the benefit of the organism.

We never have, then, a perfectly simple mental experience: consciousness is never composed of a single sensation. Two points may be noticed. (1) On the one hand, several sensations, from different sense departments, may be combined into one idea. The contributions made by a particular sense department will, it is true, be predominant in the idea; but the character of the whole process will nevertheless depend upon all the contributions sent in from the different departments concerned. My idea of lemonade is predominantly an idea of taste. But taste alone could not give me an idea of lemonade; there must be added to the taste qualities, sweet and acid, a pricking, a scent, a colour, a coolness, a 'fizzing' sound. My idea of an arm-chair is predominantly visual, a picture of the chair; but it contains also the idea of softness, of the sitting position, etc., — elements of movement and pressure. (2) On the other hand, not every sensation is called upon to assist, in equal measure, in the formation of every kind of idea. There is a division of labour. Thus visual sensations, which have the attribute of extent, are preeminently concerned in the formation of *extensive* (spatial) ideas; auditory sensations, which have no spatial attribute, contribute nothing directly to our ideas of space. We 'see' how far off a thing is, in what direction it lies, how large it is, what form it has, etc. Auditory sensations, however, possess a well-marked duration; they 'rise' quickly and 'fall' quickly with the beginning and cessation of stimulus; there is but little auditory inertia or after-image. This fact, in connection with the impossibility of their spatial arrangement, gives them an especial fitness to

arouse *temporal* ideas, ideas of frequency, succession, rhythm, etc. In all such cases we have the elevation of one attribute of sensation at the expense of others; in the cases quoted, quality, the core or 'self' of the *sensation*, becomes subordinate to extent or duration in the *idea*. In others, quality may be the predominant attribute.

We shall classify ideas, for the purposes of the present chapter, as *extensive*, *temporal* and *qualitative*. And we may confine ourselves to the consideration of those ideas which are built up from sensations of pressure (cutaneous, articular and muscular), of tone and of brightness. Pressure gives us all three classes of ideas in their earliest, most rudimentary form: the eye and the ear furnish the same ideas at their highest level of development.

The two primitive sense qualities are, in all probability, those of pressure and pain (§ 21). Pain, from its very nature, has but a small part to play in the formation of ideas. Its appearance is an indication that some sense-organ is being damaged, and it is always unpleasant. Hence a consciousness composed of pain ideas could accompany only a pathological bodily state, — a state of localised injury and general nervous deterioration, a state in which catabolic processes had the upper hand in a particular organ and in the nervous system generally. If this bodily state and this consciousness were of frequent occurrence, the organism's life would be short.[1]

Pressure, on the other hand, may be expected to form the foundation for all classes of ideas. It is a primitive sensation,

[1] It may be objected that invalids whose life is a continual pain often live to a good old age. But it must be remembered that they are cared for in a way which is unknown to the lower animals; that their pain is mitigated by medical treatment; and that they are capable of looking forward to recovery (§ 40), while the animal by its very constitution cannot anticipate the future. "While there's life, there's hope" holds only of mankind, because mankind alone can form a conscious plan of life; while, on the other hand, the fact that hope is possible robs pain of a part of its destructiveness.

the first material out of which an idea can be shaped. It possesses all four sensation attributes: quality, intensity, extent, and duration. And its quality is common to several great groups of sensory nerves, — nerves of skin, mucous membrane, muscle and joint.

We find, accordingly, that tactual ideas — ideas built up from pressure sensations, cutaneous and organic — are of all three kinds: extensive, temporal and qualitative. Since it is endowed with the spatial attribute of extent, pressure can naturally serve as the basis of the various spatial ideas: ideas of size, direction, form, position, etc. Since it is the quality aroused by movement of a limb, by friction of the articular surfaces against each other, it can serve as the basis of temporal ideas: ideas of rhythm, of rapidity of movement, etc. And though it is not qualitatively variable, though, *i.e.*, it remains the same 'pressure' whether it proceed from muscle or joint or skin, it blends with other qualities from other sense departments to form qualitative ideas: with organic sensations to form ideas of hardness, resistance, etc. (§ 16), with taste sensations to form ideas of astringency, pungency, etc. (§ 15).

Vision and audition, the senses which are richest in sensation qualities, may also be expected to give rise to a great variety of ideas. These senses stand at the other extreme of the developmental series from that occupied by pressure and pain; they are the highest products of mental evolution in the sphere of sense. Visual and auditory ideas are cast in the same mould as tactual, formed in the same way and used for the same general purposes. But they are more 'finished' and at the same time more comprehensive. Whenever a simultaneous appeal is made to the two groups, the final decision rests with vision and audition: we estimate size by look, and not by 'feel'; we take our rhythm in dancing from the music rather than from the sensation complexes set up by bodily movement.

Having considered the ideas formed from the most simple and the most highly differentiated sense materials, we shall have no need to consider any others. No sensations, except those of sight and pressure, have the spatial attribute of extent. No sensations, ex-

cept those of hearing and pressure, possess a well-marked and clear-cut duration. No other sense, not even that of smell, is so rich in qualities as are vision and audition. Hence when we have discussed our three groups of ideas in these three departments, we shall have given an outline of the formation of ideas in general.[1]

'But what of *intensive* ideas?' it may be asked. 'If the attributes of quality, duration and extent form the nucleus round which certain ideas gather, why cannot intensity serve as the nucleus of certain other ideas?' The answer is to be found partly in the nature of the attributes themselves, partly in the adjustment of the organic functions to the needs of practical life.

Quality, we have said, is the absolute and individual attribute of sensation; the others are relative or comparative, common to all sensations alike (§ 26). Quality, then, will naturally stand alone; qualitative ideas are a matter of course. My idea of lemonade is an idea built up from qualities of sensation; it does not matter how long those qualities last, or how much lemonade there is, or into how wide a glass it is poured. My perception of a musical chord is qualitative, again; duration and intensity do not occur to me, as I listen to it, — or, if they occur, are entirely subordinate to the quality of the total impression. Lemonade and the chord *c-e-g* are, first of all, *themselves* (§ 8); they are not so much of something, but something, different from other things.

But the 'how large' and 'how long' of things are often important. Hence extent and duration are *made* absolute, by reference to an arbitrarily selected unit, — centimetre, second, — for the purposes of everyday life. We must know at what hour a train goes, how many go in the course of a day, at what rate they run, etc. We must know how many miles it is to the next town,

[1] Sensations of temperature, pain and muscular pressure are probably devoid of the attribute of extent. They often enter into extensive ideas, however, owing to their customary connection with cutaneous and articular pressures.

in what direction the town lies, what its size is, how its streets are planned, etc. The temporal and spatial attributes of sensation thus become, as it were, detached in the idea from the qualities which they accompany: we can compare the distance from us of a sight and a sound, saying that "that voice comes from the other side of the wall"; we can compare the duration of a taste and a pressure, or the rate of recurrence of tones and flashes. The qualities are here irrelevant: duration and distance are in the foreground.

Intensity, however, has not been able to shake itself free of quality, as duration and extent, 'time' and 'space,' have done. Intensity is always thought of as the intensity of a particular quality; it would be meaningless to compare the intensities of sunlight and thunder-clap. Mankind has had no need to define intensity, to set up an intensive standard, as it has to define durations and extents. It is enough, in most cases, to know that a light is 'fairly bright'; a taste 'too sweet'; a sound 'exceedingly faint.' Even to-day physics has no satisfactory unit either of light or of sound. Commerce has, it is true, developed a scale of weights, which can be looked upon as varying intensities of pressure or of the complex of pressure and strain; and we accordingly possess the ideas of a 'pound,' a 'kilogramme,' etc. But these ideas are of a very simple nature. They are confined to a single group of sensation qualities, and their names hardly denote more than degrees of *sensation* intensity. They may, therefore, be left out of account here.

I. *Extensive Ideas*

§ 44. **Locality or Position.** — If we are pressed upon different parts of the body, *e.g.*, upon arm and forehead, we are able to indicate very exactly, even when the eyes are closed, the portion of skin affected: we have a clear idea of the locality of cutaneous pressure. As we sit looking at the wall opposite us, we have an equally clear idea of the position of each of the repeated patterns of the paper.

And again, if we are suddenly required to shut our eyes and describe the position of our arms, or to state the position of some part of our body which we cannot see, *e.g.*, of a leg stretched under the table, we find no difficulty in the task: we can form a clear idea of locality or position from sensations of articular pressure.

Method. — (1) Two methods have been employed to test the accuracy of *cutaneous* localisation. (*a*) The subject sits, with closed eyes, at a low table. His left arm is laid out, palm upwards, upon the table, and he holds a charcoal pencil in his right hand. The experimenter has a similar pencil, and sets it down for a moment upon the subject's left wrist: the subject, as soon as the pressure is removed, sets his own pencil down upon the same wrist, striking as nearly as possible the spot previously stimulated. Both pencils leave a mark. Hence if the subject has localised inaccurately, we can measure the amount of his mistake, and compare it with the mistakes made by other persons, or by the same individual at other parts of the skin. (*b*) The object of the second method is to determine how accurately we can localise within one and the same area. The two points of a pair of drawing-compasses are set down together upon the skin. If the distance between them is very small, they are not perceived to be two, but are taken for a single point. The distance separating them must be gradually increased. With a certain separation, they are perceived to be two, *i.e.*, separately localised.

When the points are applied in succession (first method), the average error of localisation on the wrist is from 5 to 10 mm. The subject thinks that he has struck the spot previously stimulated, when his pencil is in reality this small distance to one side of the spot. The distance between simultaneously applied compass points (second method) which enables us just to perceive their difference, *i.e.*, to localise them differently, varies for different portions of the skin and for points of different sharpness. The results obtained by the use of exceedingly fine points are: on

the finger-tip, .1 mm.; on the cheek, .5 mm.; on the upper arm, .75 mm.; on the back, 5 mm.

(2) The just noticeable difference of *visual* position at the centre of the field of vision would be that of objects separated by the minimal visual extent, .005 mm. (§ 24). If the objects are situated in the outlying portions of the field, and their position observed in 'indirect vision,' *i.e.*, while the gaze is still directed upon the central portion, our discrimination of their position is far less accurate. To assure yourself of this, use the method described in § 24; but hang the white threads at the right or left end of the grey screen, while you look steadily at a black mark placed at its centre.

(3) The just noticeable difference in the position of a limb, the least noticeable difference of 'articular position,' is smallest in the case of the largest joints. By the shoulder we can perceive a difference of position when the arm has been moved through a distance of .2°; by the wrist no difference of position is perceptible until the hand has moved through .3° (the degrees are degrees of arc described by the moved member with shoulder or wrist as centre). The values for hip and ankle are, .5° and 1° respectively. Special instruments are required for experiments in this department; the member to be moved must be laid out upon a support, and the support must be movable in various directions without any jar and without any alterations in the pressures and strains proceeding from the supported member at the beginning of the experiment.

The physiological conditions of localisation have not as yet been satisfactorily made out. The function goes back to a past so remote, and is the resultant of conditions so complex, that any hypothesis concerning it must be largely speculation. In some manner, however, the sense-organ mirrors, in its different parts, the different positions of external objects. Moreover, the organism is endowed with 'reflex' localising movements (§ 66). If a frog be deprived of its brain, and a spot of its skin irritated by acid,

the foot moves to this spot reflexly, in obedience to purely physiological laws.

But we not only localise: we consciously localise, *i.e.*, have an idea of locality. To explain this fact it is necessary to assume that the sensations from skin, retina and articular surface possess each a certain local mark or *local sign*, — some conscious peculiarity which gives them a definite space value, within the field of touch or vision. Any sensation from these three organs has, as sensation, intensity, quality, extent and duration; as constituent of an extensive idea, it has local signature as well. What the local sign is, in a given case, depends upon mental constitution.

Local Signs: (1) *Skin.* — Primitive movements (§ 62) are whole-body movements towards or away from a stimulus. Such movements have conscious concomitants, — vague processes corresponding to what will, later on, be organic sensations. We must suppose now that, as the organism was differentiated, as limbs and sense-organs appeared and the animal became responsive to an ever-growing variety of stimuli, *partial* movements, each with its own set of accompanying organic sensations, came into being. These partial movements would be called forth sometimes by stimuli in the outside world (stimuli to sight or hearing), but sometimes also by stimuli lying or impinging upon the organism itself (pressure and touch stimuli). And (*a*) the earliest 'local sign' of a skin impression is, presumably, the memory of the complex of muscle-joint-tendon-skin sensations aroused by movement of a member to the irritated spot. But (*b*) the development of the eye, once started, proceeds much more rapidly than that of the skin. Very soon, therefore, the local sign will include a visual picture of the part touched, along with the organic sensations. And presently, owing to the settled predominance of vision in the mental life and the habitual character of the localising movement, (*c*) the organic sensations will pass wholly unnoticed. The local sign of a pressure is now a sensation of a quite different order, a sensation of sight. (*d*) Finally, the visual picture itself may dis-

appear, and its place be taken by a word, the name of the part of the body pressed. Often enough, when we say that we remember an occurrence, we remember only the form of words which describes it. So now, when I am touched upon the arm, there flashes up in my mind the word 'arm,' and this word is the local sign of the pressure. (*e*) Whether the differentiation of these localising factors is paralleled by a *physiological* differentiation of the sense-organs of the skin, *i.e.*, of the parts localised, is, as was indicated above, an unsettled question.

Method. — Have yourself touched at different parts of the skin. Introspect very carefully, to discover of what processes your own system of local signs is composed. In the first few trials, it may seem to you that the pressure itself has a different quality in the different cases. But if you look closely, you will come upon the real local sign, probably a visual picture or a word.

Vision is not essential for cutaneous local signature. Those who are born blind acquire an idea of the locality of pressures. Their local sign may be (*a*) a complex of organic sensations; (*b*) a tactual map or picture of the part touched, *plus* the organic sensations; (*c*) the tactual map alone; or (*d*) a word. The 'tactual picture' is aroused and perfected by movement of the fingers over the touched spot; its components would be extent of pressure, *i.e.*, the distance travelled over by the finger before it came to the edge of limb or trunk, certain hardnesses or softnesses of surface, etc. It is not easy for us, who see, to form an idea of such a 'picture'; but it undoubtedly exists.

(2) *Joint.* — The local sign is here either (*a*) a complex of organic and pressure sensations, aroused by the tension of skin and tendons and the contraction of muscle; (*b*) a complex of these and visual sensations; (*c*) visual sensations; or (*d*) a word.

(3) *Eye.* — It has been suggested that the original local marks of the retina were also (*a*) organic sensations. The eyes turn reflexly towards an object which has suddenly appeared in the field of vision, so that the object is brought opposite to the centres of the retinæ, the spots of clearest vision. The movements were originally conscious, *i.e.*, attended by sensations of strain and contraction; and the memory of these organic sensations may have

formed the primitive local sign of the eye. There can be little doubt that the sensations in question are capable of the delicate gradation which would be necessary if they were to form the basis of the visual idea of locality. We know, however, (*b*) that the same stimulus occasions different sensations, according to the part of the retina upon which it acts. What is red to the centre of the retina becomes bluish or yellowish as it moves outwards, and finally passes into a grey. We do not notice any differences of quality within a field of colour, because we have often moved our eyes over the entire surface of such fields, and thus learned that objective differences do not exist. But it may be, nevertheless, that they constitute the earliest local signature of the eye.

These ideas of locality are ideas of the position of an impression upon an extended surface. We perceive the place of a pressure upon the surface of the body, the position of a particular pattern upon the extent of wall before us, the position of a limb within a plane of movement. But we possess other ideas of locality, ideas of the position of an object in three-dimensional space, which include the idea of distance from our own body. We can find where a thing is, in the dark, by stretching out our hand towards it; we can estimate the distance of a visual object from ourselves, or from some other object which we say is before or behind it. The tactual idea of locality, in this second sense, is not hard to explain; the visual idea has been variously accounted for.

The Third Dimension: (1) *Tactual Idea.*— The tactual idea of distance in the third dimension arises from the connection of extents of cutaneous pressure with the articular sensations called out by movement. The whole body or a bodily member moves towards the object, and comes into contact with it. Hence we have the tactual measures of distance,— foot, span, cubit, etc.

(2) *Visual Idea.*— The corresponding visual idea has been explained in two ways. (*a*) The two eyes look at the same

object in space from two slightly different points of view. We can take two photographs of the object from these points of view, placing a camera where each eye would be. Let us paste these photographs side by side upon a strip of cardboard, and lay the strip in a stereoscope, so that the photograph taken by the right hand camera is presented to the right eye and the other to the left. We see one picture only; but this picture is very different from either of the separate photographs. It looks solid: we have an illusion of tridimensionality. From this it has been argued that we perceive distance because the pictures formed upon the two retinæ by the same object are different; and that we perceive differences of distance, because the differences between the two pictures increase or decrease, according as the object is near or far. On this view, the perception of tridimensional space follows directly from the bodily conditions of vision; it is a necessary consequence of the double structure and single function of the organ of sight. Because we see one thing with two eyes, we see it as a solid. (*b*) Another hypothesis lays stress upon the strain sensations which proceed from the tendons by which the eye-muscles are attached to the eyeball. The strain sensations differ in intensity, according as the object upon which the eyes are 'converged,' *i.e.*, to which they are both directed, is situated at a greater or less distance from the body. The nearer the object, the greater the strain of ocular convergence; the more remote the object, the less the strain. In this way, it is said, intensities of strain furnish a measure of the amount of distance.

Method.—To test the discrimination of the eye for distances in depth, we hang a fine black thread midway between the face and a white screen or wall. The thread is gradually moved backwards or forwards, by an assistant, until a difference of position (distance) is perceived. The subject should close his eyes during the interval between experiment and experiment, and during the time when the assistant is altering the position of the thread in a given experiment. On opening the eyes, he should look first at the white screen, and from that to the thread: the position of the eyes and strain of the eye muscles will thus be the same at the beginning of each experiment. The just noticeable

difference of ocular convergence is one-fiftieth of the distance of the thread from the observing eyes (*cf.* the expression of Weber's law for strain sensations: §§ 27, 28). It is noteworthy that with a very slight degree of ocular convergence, *i.e.*, when the thread hangs at a considerable distance from the eye, this difference of one-fiftieth corresponds to the least difference of position which the eye can perceive on a plane surface. In concrete terms, if the thread is moved from a distance, say, of 200 cm. to one of 196 cm. (one-fiftieth nearer), the distance separating the two pictures which it throws on each retina in its two positions is .005 mm. (*cf.* Fig. 6).

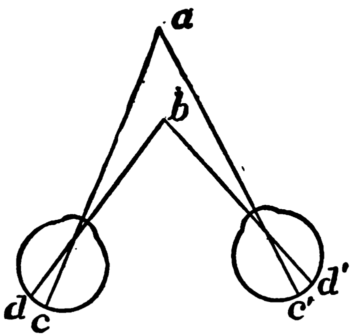


FIG. 6.—The eyes are converged upon the thread a; the thread throws two images upon the two spots of clearest vision, c, c'. If the eyes are now converged upon the thread at b, the yellow spots will move to the positions d, d'. Under the conditions stated in the text, when the distance a–b is one-fiftieth of the total distance of the thread a from the eyes, the retinal distances c–d and c'–d' are .005 mm.

This fact seems to show that the sensations aroused by eye movements are capable of serving as the conscious local signs of visual sensations.

It is impossible, in the present state of our knowledge, to decide between the two hypotheses given above. It may be that both contain a part of the truth,—that eye movement is the primary factor in the idea, but that it is assisted by the difference between the two retinal images. Certainly, the importance of movement for the tactual idea of locality suggests that eye movement may be of similar importance in the sphere of sight. And the number and arrangement of the twelve eye muscles lead us to ascribe some important functions to them,—just as the number and arrangement of the six semicircular canals indicate that they play

some important part in the total adjustment of the organism to its surroundings. The circumstance that in adult life we pay but little attention to the strain sensations aroused within the eye sockets does not count for much: we may have attended to them in childhood, *i.e.*, at a time when we were incapable of introspection; or attention to them may date still farther back, to an earlier stage in the evolution of organic life. Moreover, as our experience grows, we learn to infer the distance of an object by means of certain indirect or secondary criteria (§ 53), so that when the strain sensations had done their work they would naturally be replaced by other conscious processes.

Those who accept the hypothesis of eye movement as correct declare that the apparent solidity of the combined stereoscopic pictures is not due to the bodily conditions of vision. It is not a direct consequence of the fact that we see one thing with two eyes, but rather a matter of habitual interpretation. We see in the stereoscope a surface of broken and irregular outline, and we construct a solid from this surface, by the help of remembered eye movements or of the secondary criteria just now referred to.

Vision is by far the most important of the localising senses. Our idea of the posture or attitude of our body generally takes the form of a mental picture, although it might have been built up from articular sensations; and our idea of the locality of a pressure, or of the position of an object which we 'feel' in the dark, is as a general rule a visual map of the place touched or of the object among its surroundings. If there is a conflict between the tactual and visual ideas, the visual wins, — we trust our eyes.

Method. — Cross the second finger of the right hand over the forefinger, so that the top joint of the second finger points to the thumb. Take up a marble between the crossed finger-tips. You have two pressures: one from the right-hand side of the second finger, and one from the left-hand side of the forefinger. If the fingers were occupying their normal positions, these sides could

not be pressed by the same object; and therefore, if you trust to your tactual idea of locality, you must suppose that you are holding not one marble, but two. But so accustomed are we to form a mental picture of what we are touching, that you will not be able at first to get the idea of two objects from the single marble, if you yourself take it up between your fingers. Close your eyes, and let an assistant put the marble in position in the course of a series of experiments with stimuli of whose nature you are not informed. Under these conditions you will judge that there are two objects in contact with your skin; and having thus formed the true tactual idea, will be able to 'feel' the marble as two even with your eyes open. But you regard it, of course, as one marble: the evidence of sight is believed.

This experiment is as old as Aristotle. It is described in the Aristotelian tract "On Dreams," and the author explains it just as we have done, remarking that "sight stands above touch."

§ 45. **Form and Magnitude.** — Our ideas of shape and size are, like those of position, of two kinds: superficial, ideas of the shape and size of pressures on the skin or patterns on a seen surface, and tridimensional, ideas of the shape and size of objects in space. Vision can furnish both kinds of ideas. Skin and joint together give us ideas of the form and magnitude of objects of three dimensions. The skin alone cannot do this; if we had no eyes, and were unable to move, our ideas of form and size would be superficial only.

A 'form' is an extent which is bounded or limited in a certain way. When we look at a black mark on a grey surface, the boundary lines of the black mark naturally attract our attention: it is there that the contrast between the two qualities begins (§ 38). As the eye follows different boundary lines, it traverses different distances and rests at points of different position. Different names have been

given to the impressions which call forth in this way different complexes of sensation in and about the eye: circle, square, cross, etc. The differences between the stimuli are differences of form.

'Size' is 'so much' of a certain form. One square is twice the size of another when the extent comprised within its boundary lines is twice the extent comprised within the quite similar boundary lines of the other figure.

(1) *Superficial Ideas.* — (*a*) The cutaneous idea of form can be tested by applying to the skin surfaces of different shapes (squares, circles, etc., cut from wood or hard rubber). It has been found, *e.g.*, that a triangular surface, if applied to the tip of the tongue, must have sides of 2 mm. length, if applied to the tip of the middle finger, sides of 6 mm. length, if it is to give rise to the idea of a triangle.

To test the cutaneous estimation of size, apply a series of circles, triangles, etc., of gradually increasing size, to some part of the skin. Two circles are of just noticeably different size for the tip of the tongue if their diameters are .5 and 1 mm. respectively.

The 'cutaneous size' of a surface is less than its 'visual size.' When, that is, we think of the surface in terms of a passive pressure upon the skin, we think of it as smaller than it 'looks.'

(*b*) The visual idea of superficial form was originally gained by the help of movement, whether of the eye itself or of the stimulus. Either the eye moved along the boundary lines of the figure, or the figure, contained within its boundary lines, moved across the otherwise unchanged field of vision. After a time, these movements became unnecessary. The practised retina is able to distinguish shape at a glance (§ 53).

The just noticeable difference of visual size can be determined by a method similar to that described in § 24, except that, in place of threads, figures cut from cardboard must be used.

(2) *Tridimensional Ideas.* — (*a*) The tactual idea of form, an idea derived from the connection of sensations from skin and joint, is capable of a high degree of development. The

blind, as is well known, read a 'raised print' easily and accurately.

(*b*) The visual idea of tridimensional form is made up of the idea of superficial form *plus* the perception of distance.

The 'tactual size' of an object is generally larger than its 'visual size'; an object 'feels' to the moving hand larger than it looks. The tactual idea itself differs, according to the member by whose aid the estimate is made. The cavity of a hollow tooth seems greater to the tongue than it does to the finger. To both, it is greater than it is to the eye.

The visual idea of the form and size of an object is most prompt and certain when the boundary lines of the object are unbroken; the tactual idea, when they are broken. An object in the field of vision stands up more distinctly from its surroundings if its outline is continuous; but a tactual form stands out most distinctly from its background if the outline is interrupted. Test this by trying to read, with your finger-tips, two sentences, one printed in ordinary raised print, the other in the dotted blind-print. It is easier to 'feel' a raised P when it is printed ⠏ than when it is printed in the form P.

There are two special questions which call for notice under the head of the visual idea of form. These are the questions of the continuity of the field of vision, and of the re-inversion of vision.

(1) *The Blind Spot.* — When we look out over a landscape, we see it as an unbroken expanse. The field of vision is continuous; there is nowhere any interruption of outline, any gap in the series of impressions. Yet the retina is not sensitive over its whole surface. Like the skin (§ 16), it is a mosaic of sensitive points. And the retinal mosaic, unlike the cutaneous, has within it one very large area which is altogether insensitive, — the place of entry of the optic nerve.

Method. — It is easy to assure yourself that you are blind to certain stimuli in the field of vision. Seat yourself at a convenient distance from a white screen. Close the right eye, and keep the left steadily directed towards a small black disc pasted upon the screen. Let an assistant move a similar black disc, held

upon a light rod, slowly across the screen, starting from the point of regard, and travelling towards your left. At first, as you look at the fixed disc, you will see both that and the other: the first in direct and the second in indirect vision. But after a little time, the moving disc will suddenly disappear. Yet it has not passed beyond the limits of the field of vision; for if the assistant move it still further to your left, there comes a point where it as suddenly reappears. The distance from point of disappearance to point of reappearance is the breadth of the blind spot; this can be marked in pencil upon the screen. The form of the blind area can be determined by moving the black disc along all the various meridians, vertical and oblique, and marking on the screen all points of disappearance and reappearance.

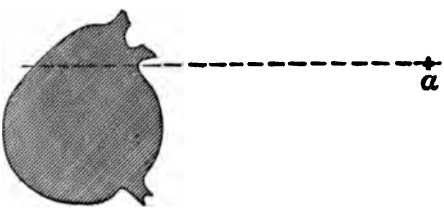


FIG. 7.—Blind spot of the author's left eye (plane projection). Reduced from a large diagram, in which the distance from the inner edge of the point of fixation, *a*, to the inner edge of the blind spot was 54.5 cm. The distance of the point of fixation from the eye, in the experiments, was 2.2 m.

Plainly, then, there is here a problem to be solved. The field of vision is broken; yet, in ordinary life, we do not perceive that it is broken. Two explanations have been offered. (*a*) 'At the blind spot,' it is said, 'we do not see *anything*. If we saw a hole or gap in the field of vision we should be seeing *something*. As we see nothing, the field must appear to be unbroken.' This explanation might be accepted, were there not experimental observations which tell against it. For instance: we can estimate the distance between two points whose retinal images lie on either side of the blind spot as well as we can that between any other two points seen in indirect vision. Now if the explanation just given were correct, the two edges of the blind spot ought to come together, and two points lying one on either side of the spot to be brought so much nearer each other. Since the blind spot does not interfere with our estimation of visual extent, the space in the

field of vision to which it corresponds must be somehow *filled up*. This can be shown, again, in the following way. If we look at a printed page, under such conditions that the words at its centre fall upon the blind spot, we find that though the central words are not legible, there is visible in their place a hazy whiteness. Something is seen, though the something does not agree with the stimuli actually presented. (*b*) Evidently, then, the blind spot is blind only to peripheral impressions; the area which it occupies in the field of vision is filled up by centrally aroused sensations, of the same general character as those aroused in the peripheral organ — sensations of greyish white, if we are looking at a printed page, of red if we are looking at a red surface, etc. The reason for these central sensations is to be found in the fact that the eyes can move. We have only to sweep our eyes over the printed page to discover that it is an unbroken surface; we can read consecutively from the top line to the bottom. We have moved our eyes over visual surfaces so often that we cannot help thinking of them as continuous; and this thought is confirmed in every case of actual movement. Here, as in many other cases, we have lost sight of the conditions under which the idea grew up, and look upon the continuity of the visual field as a fact of direct perception.

There can be no doubt that this explanation is correct, and that eye movement accounts for the filling up of the blind area. There is another circumstance, however, which assists eye movement in its task. The blind spots do not occupy the same position in the two eyes: so that, when we look with both eyes at a landscape, the part to which one eye is blind is seen by the other. This fact makes the continuity of the field a matter of course, when both eyes are used. But it is not sufficient to explain all the facts: it does not explain the continuity of a field seen with only one eye.

(2) *Reinverted Vision.* — The rays of light proceeding from an object in the field of vision do not pass straight through the pupil to the retina, but cross at a point within the eyeball, and thus form upon the retina an inverted image. Since this fact has been known, the question has often been asked: How is it that

we see objects the right way up? How does it come about that the retinal image, which is upside down, is set right again, reinverted?

The answer is that we do not see what goes on in our eyes, but what is set before us in space: just as we do not hear what goes on in our ears, but hear the sound which is outside of the ear. Mankind saw things the right way up long ages before any man knew anything of the disposal of light rays upon the retina. We learn the up and the down of things by experience: that is up, which is where our head is; that is down, which is where our feet are. The retinal image need be no more like the thing seen than the shake of the fibre of the basilar membrane is like the sound heard, or the chemical action of salt upon the tongue like the taste of salt in the mouth.

The disposal of light rays upon the retina becomes important only when we wish to examine the mechanism of the eye as a piece of physical apparatus. We find, either by examining another person's eye with a special instrument, or by constructing an artificial eye of lenses and ground glass (a camera), that the 'image' formed by the entering rays is inverted. It is a physical necessity that this be the case, if the eye is to serve the purposes of vision, *i.e.*, if it is to 'work' as an optical instrument. But the fact is irrelevant to psychology. Nobody has ever seen his own retinal 'image.'

§ 46. **Extent of Movement.** — Movement is a continuous change of position. The materials for the idea of movement are, therefore, in part the same as those for the idea of locality. Our idea of movement is made up, in part, of the ideas of an object in different positions. The other factor in the idea of movement is the persistence of sensation after the cessation of stimulus. By the help of an after-image or of memory we are able to perceive an object, as it were, in two places at once: in the place which it has just left, and in the place to which it has

just come. Here we have the sense-material for the continuity of change of position which the idea of movement includes.

Our idea of movement is an idea which is at once extensive and temporal. Every movement is a movement so far, and also a movement during a certain time. Movement has *extent*, and is therefore an extensive idea; it has *rate* or rapidity, and is therefore a temporal idea.

Our estimation of the extent of movement may be founded upon sensations from skin, joint or eye.

(1) *Skin.*—As a stimulus moves over the surface of the skin, it arouses sensations of different local signature. Each of these sensations lasts for a short time after the removal of the stimulus; but the after-image of pressure is very brief,—too brief to be of much assistance to us in forming an idea of the distance passed over by the stimulus. On the other hand, we can remember each impression, for a little while, with great accuracy. Our estimation of the extent of movement, in purely cutaneous terms, is restricted to movements of stimulus which are either so short or so quick that the first local sign has not lapsed from consciousness when the last is reached. In all other cases, we are either entirely uncertain as regards the extent of movement, or make our estimation in terms not of pressure but of sight.

The stimulus must pass from local sign to local sign, *i.e.*, travel a certain distance, before its movement is remarked at all. And if the pressure is very light, or the movement very slow, we may have no idea of movement; the first local sign may be forgotten when the next is reached. The distance passed over on the forearm before movement is noticed may amount to 10 mm.

Method.—Move a charcoal point lightly in different directions over the skin of wrist or forearm, keeping the rate of movement as uniform as you can. Measure the distance which the point travels, in each case, before the subject cries out that it is moving. The distance will be greater if you move it upwards or downwards than if you move it across the limb. This is because localisation,

conscious or unconscious (physiological), is less accurate upon the long axis of the body; the local signs are less thickly strewn, so to speak, than they are upon the short axis. And this, in its turn, is because we increase more in height than in breadth as we grow: we grow 'up.' Hence the nerve-endings in the skin are pulled further apart in the up and down directions than they are in the transverse.

(2) *Joint.* — The idea of movement which is derived from articular sensations is always the idea of a movement of our own body or some part of it. The just noticeable extent of movement is, of course, the distance which the limb must travel to arrive at a just noticeably different position (§ 44).

Method. — Lay a board, about 50 cm. long and 15 cm. wide, upon a low table. Place the forearm, palm downwards, upon the board, with the elbow projecting just beyond its near end. Close your eyes. Let an assistant raise the far end very carefully and gradually. Measure the height from the table to which the board may be raised before you have any perception of movement from the elbow-joint. To avoid jar at starting, it is best to have the near end of the board hinged to the table, and its far end raised by a cord running through a pulley.

(3) *Eye.* — The visual idea of extent of movement is differently formed, according as the eyes themselves move or remain stationary.

(*a*) If the eyes are fixed, visual movement, like cutaneous, can be estimated only in cases where the sensations first aroused, or their after-images or memories, are still running their course in consciousness when the last make their appearance. The eye has, here as always, the advantage of the skin: retinal sensations persist in after-images far longer than cutaneous, and after-images are more reliable than memories.

The just noticeable movement, for the unmoved eyes, is the same as the just noticeable difference of visual position (§ 44).

(*b*) But the head or eyes may move, following the moving stimulus. In this case, the retinal image of the object is kept constantly upon the same portion of the retina, instead of passing from one portion to another. Here, the estimation of movement

is of the articular type: the eyes turn in their sockets, or the head upon the shoulders, as the forearm turns in the elbow-joint.

Estimation in terms of eye movement is very uncertain, unless there is somewhere in the field of vision a fixed point, to which we may refer when making it. The fixed point serves the same purpose under these circumstances as the persistence of the first sensation does when the eyes are not moved, or when we are forming our idea from cutaneous sensations. In the latter cases, the stimulus is spread over all points of its course at once: the movement, from starting-point to finish, is filled up with memory, after-image or peripheral sensation. In the present instance we have the fixed object as starting-point, and the final position of the moving object as finishing-point; while the fact of movement itself is perceived from the series of pressure sensations aroused by the turn of the eyeballs in their sockets, and of strain sensations aroused by changes of ocular convergence.

It may seem strange that eye movement, which is so important in other connections (eye measurement and convergence), should prove to be of such slight assistance in the formation of the idea of the extent of movement. In reality, it is just because of these other functions that the strain sensations are unable to help us now. In eye measurement, the eye moves from a fixed point and sweeps over a line; in convergence, the eyes rest upon a certain fixed point at a definite distance from the body. If we take away the fixed point, as beginning or finishing point of movement, the sensations set up around the eyeball are uncertain guides. Movements of the eyes to and fro are very frequent, and very rarely remarked. Hence without the fixed point of reference we may make grave mistakes, even if we base our idea upon the true articular sensations produced by rotation of the head: unnoticed movements of the eyes may have added something to or subtracted something from the result of head movement.

Method. — The following experiment shows the uncertainty of estimation of extent of movement when the eyes are allowed to move, in the absence of a fixed point of reference. Seat yourself in a dark room. An assistant holds a dark lantern, by which he can throw a faint spot of light on the wall before you. The

spot is shown at irregular intervals and for different lengths of time; sometimes it is still, sometimes moved slowly to or fro. You will find that your judgments of its stationariness and movement are frequently incorrect.

II. *Temporal Ideas*

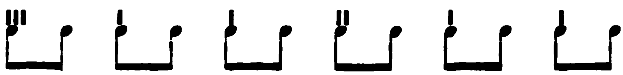
§ 47. **Rhythm.** — When we walk, we have a regular alternation of strong and weak sensation complexes. We are resting, perhaps, on the left foot. This means a mass of strong pressures on the sole of that foot, a severe pressure in knee and hip, etc. The right foot swings forward. This means a complex of weak pressures (after-images, pressure of boot) from the sole of that foot, and a perception of movement — with relaxation of pressure, however — in knee and hip. The right foot is then set down: strong. The left leg swings forward: weak. The left foot comes down again: strong, — and so on. A similar alternation is observable in respiration. We inspire, short; expire, long; inspire, short; etc. These alternations of strong and weak, long and short sensation complexes are the basis of the idea of rhythm.

The auditory idea of rhythm has been far more highly developed than the tactual. We cannot listen to any fairly rapid succession of sounds without putting rhythm into it (§ 42). Sounds are, indeed, better material for the idea of rhythm than are tactual complexes; for the limbs are fixed to the trunk, and can therefore do no more than oscillate to and fro, pendulum fashion, giving of necessity the most rudimentary form of rhythm, — beat′ beat, beat′ beat, — whereas a series of sounds can be divided into groups of any complexity. The rhythm: beat″ beat beat, beat′ beat beat, beat″ beat beat, beat′ beat beat, could

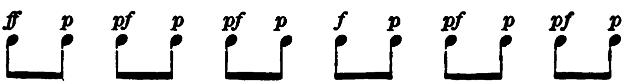
not be formed from tactual impressions, but is easily constructed when we have a succession of free stimuli, and can place the changes of intensity at any desired point in the succession.

Hence it is intelligible that, in cases of conflict, auditory rhythm should outweigh tactual. When we think of the rhythm of walking, we do so as a rule under the form: left′ right, left′ right, etc., and not under the form: press′ swing, press′ swing, etc., as given above. This is because we think of walking in terms of hearing, we listen to an imaginary march. The swing is noiseless; and the accent is consequently placed upon one of the two treads.

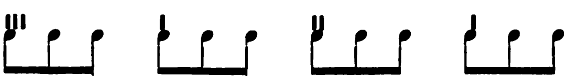
The simplest auditory rhythms are successions of two or three beats, one of which is stronger than the other or than the other two. The poetical 'feet,' iambus, trochee, dactyl and anapæst, are instances of the four possible forms which these simplest rhythms may take: ∪—, —∪, —∪∪, ∪∪—. The musical 'measure,' which corresponds to the poetical foot, may be far more complicated. Thus we may have twelve impressions, accented as follows:



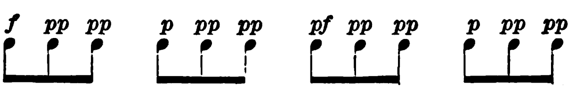
in music written, perhaps,



or accented in this way:



in music written, perhaps,



i.e., a succession of four or six simple rhythmical forms, with four degrees of accent or intensity.

Above the foot stands the line or verse; and above the measure the phrase. These represent a further development of the auditory idea of rhythm; they are rhythmical wholes, just as are the foot or measure, but rhythmical wholes of a higher order. Neither can contain more than six feet or measures: a seven-footed line or a seven-measured phrase falls to pieces, ceases to be rhythmical.

Once more: above the verse comes the stanza; and above the phrase stands the period. These are rhythmical wholes of a still higher order. Neither can contain more than five verses or phrases; as a general rule, neither contains more than four.

Method.—Set a metronome beating, with an interval of about a quarter of a second between stroke and stroke. Try to throw the beats into all the different possible rhythms, trochaic, iambic, etc. You will find it quite easy to change from rhythm to rhythm, especially if you use movement to assist you,—moving foot or hand when the beats come which you wish to emphasise. Then see how complex a foot or measure you can construct in the various rhythms.

We found in § 42 that the attention could grasp 40 metronome beats as a single whole, if these were apprehended as 5 impressions of 8 beats each. This is the extreme range of attention, under experimental conditions. The measure or foot is here a trochee; the verse or phrase contains four feet or measures accented as follows:

and the stanza or period contains five verses or phrases.

§ 48. **Rate of Movement.**—Our estimation of the rate, as of the extent, of movement may be founded upon sensations from skin, joint or eye. It is a general rule, in all three sense departments, that quick movement is more readily perceived than slow.

(1) *Skin.*—A stimulus which travels at a uniform rate over the skin does not give rise to the idea of uniform movement. We take the movement to be quicker at parts of the skin upon which localisation is accurate than at parts where it is inaccurate. In the former case more local signs are aroused in the time occupied by the movement; the movement has a more varying contents. A more diversified contents in a fixed time is perceived as a greater rapidity of movement during that time.

Method. — Draw a pencil point at a uniform rate from shoulder to finger-tips. Its movement will appear to quicken and slacken as it passes over areas of greater and less localising power.

On the other hand, if a thread be drawn by an assistant between your forefinger and thumb, at first quickly and then more slowly, you will not know that the same length of thread has been employed: the thread will seem to be shorter in the first experiment than in the second. If it is pulled quickly, you receive no clear impressions from its irregularities; you have one blurred impression. If it is pulled slowly, you perceive all the roughnesses and unevennesses of its surface; the movement has a more diversified contents. Here, diversified contents in a longer time is interpreted as a greater extent of thread.

(2) *Eye.*—The eye can just perceive a movement, in direct vision, if its rate is that of .0028 mm. in the second.

It is difficult to compare the rapidity of two movements, to say which is the quicker and which the slower, if the movements are at all quick. The after-images of the moving stimulus persist so long as to render an estimation almost impossible.

(3) *Joint.* — All that we know of the rapidity of articular movement is the general fact stated above. Quick movements are more readily noticed than slow. This can be shown by the help of the apparatus described in § 46.

The following plan might be followed to test how accurately we can compare the rate of articular movements. Lay the right hand upon a low table. Bend the three last fingers and the thumb, leaving only the forefinger extended. Insert the tip of this finger in a metal cap, which is carried upon a smoothly running wheel. The wheel must be run by clockwork, or by weights hung below

the table; and its speed must be variable, and known in each experiment. Let an assistant set it so that it carries the finger over the same distance in two successive movements, but at different rates. Find the smallest difference of rate which is perceptible with a constant extent of movement.

If the whole body is moved, without jar and at a uniform rate, the movement passes entirely unnoticed. If the movement slows or quickens, however, it is perceived at once. The perception may be due to the inertia of the body: we are carried forward as the movement slows, and jerked backward as it quickens. The suggestion has also been made that the acceleration of movement sets up a wave in the endolymph of the internal ear, and that we consequently owe its perception to the static sense (§ 20). If this is correct, the static sense has two qualities, giddiness and a peculiar pressure, and the latter unites with the sensations produced by the inertia of the body to give us the idea of increased or decreased rate of movement.

III. *Qualitative Ideas*

§ 49. **Clangs.** — A clang is an assemblage of tones. It is the conscious process which corresponds to a compound air-wave, as the tone corresponds to a simple wave-movement of the air particles.

When we hear a chord of three or four notes struck upon the piano, we realise that it is a chord, *i.e.*, a perception, and not a single tone, a sensation. But we realise, also, that the notes of the chord somehow fit together, belong to one another, form a single impression. If we sound three or four neighbouring notes, we obtain a very different effect: the complex 'falls to pieces,' the notes seem mutually repellent. As compared with a single note, the chord is complex; as compared with a discord, it is a single impression.

But not even the note is a sensation, an unanalysable elementary process; it is a clang, composed of a number of tones. The strongest tone gives name and character to the note, but other, weaker tones are always present in it. To a trained ear there is as much difference between a note and a tone as to the untrained ear between a note and a chord or a chord and a discord.

It is clear from these instances that under certain circumstances tone qualities can mix or blend together, their mixture giving rise to a single total impression, a single perception; while under other circumstances they remain separate, and are distinctly sensible in the complex impression. In the note we have the highest degree of tonal fusion, as it is called: one of the constituent tones is so strongly predominant as to give its own quality to the whole assemblage. In the chord we have a less complete fusion. It is true that each of the component notes loses something of its qualitative distinctness, and that the chord is a single perception. But the hearer cannot doubt, as he can in the case of the note, that the perception is a complex of simple processes; with a little trouble he can distinguish these, the tones, in the total mass of sound. Lastly, in the discord we have the lowest degree of fusion, the refusal to blend: the component notes stand out side by side.

The note is known technically as the *simple* clang; the chord and discord as *compound* clangs.

The strongest tone in the note is termed the 'fundamental.' The other, weaker tones are 'overtones.' When a violin string is plucked, it vibrates not only as a whole, but in sections as well: half, third, quarter, etc. The fundamental is the tone of the whole

string; the overtones are the tones corresponding to the vibrations of the half-string, third-string, quarter-string, etc.[1]

What holds of the violin string holds of any vibrating body: metal rod, mass of air, etc. We always have a fundamental tone and a series of overtones. As a general rule, the overtones become weaker, the farther they are removed from the fundamental: the vibration of the quarter-string gives rise to a weaker tone than the vibrations of the half-string and third-string. But the relative strength of the overtones is different in the case of different vibrating bodies. Thus the air masses of the viola and clarionette vibrate in thirds, fifths, sevenths, etc., more strongly than in halves, quarters, sixths, etc.; the hammer strikes the piano string in such a way that the sixth overtone does not sound; the reed-pipes of an organ give a regular series of overtones, which decrease in intensity, in accordance with the general rule, from the lowest upwards. The note of each musical instrument thus has a peculiar character or colouring;

[1] As the overtones correspond to the vibrations of the half, third, quarter, etc., of the vibrating body, their vibration rates will be twice, three times, four times, etc., that of the fundamental. If we represent the fundamental vibration rate by 1, the overtones will have the vibration rates 2, 3, 4, 5, 6, etc.; if we represent it by 2, the overtones will form the series 4, 6, 8, 10, 12, etc.

The relation of the overtone to its fundamental must not be confused with the relation of the two tones composing a musical interval. The sixth overtone, *e.g.*, does not make with its fundamental the musical interval of the sixth. The notes of the musical scale are named *a*, *b*, *c*, *d*, *e*, *f*, *g*. The musical intervals are calculated by reference to these names. Thus *a–c*, *b–d*, *d–f*, *e–g*, *f–a* are all thirds: three notes are involved in the composition of each. So *a–e*, *b–f*, *c–g*, etc., are all fifths: five notes are involved in the composition of each one.

The vibration rates of the chief musical intervals form the following ratios: octave, 1:2; fifth, 2:3; fourth, 3:4; major sixth, 3:5; minor sixth, 5:8; major third, 4:5; minor third, 5:6; second, 8:9; major seventh, 8:15; minor seventh, 5:9.

We can now state the relation of overtone to fundamental in terms of the musical intervals. The series, with 1 as fundamental, is:

1: 2 3 4 5 6 . . . .

Fundamental and first overtone constitute an octave; fundamental and second overtone, an octave and a fifth; fundamental and third overtone, two octaves; fundamental and fourth overtone, two octaves and a major third; fundamental and fifth overtone, two octaves and a fifth, etc.

or, technically, the clangs of different instruments have different *clang-tints*. — It is a difference of clang-tint which differentiates the vowel sounds of the human voice. The larynx, which with the resonance-cavity of the mouth constitutes the primitive musical instrument, is thus seen to be in reality a number of instruments: an *a*-instrument, an *o*-instrument, an *u*-instrument, etc. This fact accounts, in part, for the superiority of the voice over any string or wind instrument in the matter of expression. The violin approaches nearest to the voice, since the violinist can vary the overtones of his instrument, within wide limits, by striking the strings at different points; and can thus evoke notes or chords of different clang-tint.

Method. — The analysis of a note into its constituent tones is most easily performed by the aid of a sonometer and a set of resonators, such as are used in the physical laboratories. The sonometer is an instrument somewhat resembling a single-stringed violin; and the resonators are bottles of glass or metal, each of which contains a mass of air whose vibration corresponds to a particular tone. The sonometer string is plucked, and its vibrations give rise to a clang. The resonators are applied to the ear in quick succession, during the sounding of the clang. All those whose peculiar tone is among the overtones of the clang send a loud sound into the ear: the others are silent.

If you have not these instruments, try the following experiment with a piano. The middle *c* of the scale contains in it a number of overtones, the loudest of which are the c' and g' of the next octave, and the c'', g'' and e'' of the octave above that. Sound one of these last notes softly by itself; and when you have it 'in your head,' strike the key of the middle *c*. You will be able, with a little practice, to hear the overtone, which you have just listened to separately, ring out from the body of the clang.

Experiments upon compound clangs, chords and discords, are best made with a set of tuning-forks. Tuning-forks give pure tones; not clangs. If they are not available, you can again make use of a piano. Let an assistant strike the various musical 'intervals' within the middle octave of the scale, in haphazard order. Record your judgment of the composition of each clang sounded, your judgment, *i.e.*, as to whether it contain two notes or only

one; and note further whether you decide promptly or hesitatingly. If you feel that it is impossible to judge impartially when you know that two notes will be given in each experiment, let the assistant intersperse the series of intervals with occasional single notes. In this way you will avoid the expectation error.

You will find that the interval of the octave (c–c') is most often taken to be a single note; less often the fifth (c–g); still less often the fourth (c–f); seldom the thirds and sixths (c–e, c–$\flat e$, c–a, c–$\flat a$); never the second and sevenths (c–d, c–b, c–$\flat b$). The octave shows the highest degree of fusion, the second and sevenths the lowest.

You can then go on to experiment with groups of three and four tuning-fork tones or piano notes, arranging these more complex clangs in the order of fusion, from the highest to the lowest degree. Or you can alter the intensity, either of all the component tones or notes, or of some one of them; and see whether the degree of fusion is changed by these changes of intensity.

Clangs are typical of qualitative ideas in general: of the ideas built up from sensations of smell and taste, of the qualitative complexes of pressure and temperature, of the mixtures of pressure with organic sensations (resistance, impact, etc.), and of the mixtures of colour and brightness; and they furnish the best illustration of the way in which qualitative ideas are formed. For (1) we are or can be as familiar with the elementary component processes as we are with their mixture; whereas we never get colour apart from brightness, and only with difficulty get strain, articular pressure, etc., separate in experience; (2) the universal distribution of musical instruments makes it possible for any one to examine them; and (3) they show all degrees of blending, from an almost unanalysable singleness of impression (the tuning-fork octave) to an unmistakable complexity (second or seventh).

§ 50. **Melody.** — As movement is both temporal and spatial, so melody is both temporal and qualitative. It presupposes both clang and rhythm.

A melody is, in the first place, a succession of single clangs. These clangs cannot be chosen at random; we know that a mere sounding of clangs, one after the other, does not give rise to what we call a tune. The composer has always to select from a definite series of clangs. Or, in other words, every melody, however primitive it may be, is composed in a certain *scale*, however rudimentary. Its clangs, *i.e.*, are chosen from a restricted number, arranged at approximately fixed intervals.

It is probable that all scales begin with the interval of the descending fourth. A *c* being given, the first note to be fixed is the *G* of the octave below. After this *G*—or possibly, in some few instances, before it, as the first added note—comes the ascending fifth, the *g* of the octave of which *c* is the lowest note. The other notes of the scale are gradually established between these limits, *G–g*, as the musical appreciation of mankind develops.

We are accustomed to think of a scale as beginning in the bass and continuing upwards towards the treble. It is natural, however, that the primitive scales should descend, run from treble to bass. The earliest melody must have been very like our recitative: and the voice falls or drops at the end of each sentence.

The descending scale rests, first of all, upon the fourth below its starting-point, because this interval is the ordinary drop of the voice in speaking. It rises, first of all, to the fifth above its starting-point, because this is the ordinary rise of the voice in questioning.

The scale which has been universally adopted in Western music is an ascending scale of twelve notes (semitones) to the octave. These notes are *c*, ♯*c* or ♭*d*, *d*, ♯*d* or ♭*e*, *e*, *f*, ♯*f* or ♭*g*, *g*, ♯*g* or ♭*a*, *a*, ♯*a* or ♭*b*, *b*. Traces of other scales are occasionally found: *e.g.*, in Scotch bagpipe music.

As the scale becomes complex, the rules of melody necessarily

become precise. Hence we have such canons as that the melody must begin and end with the same note, the 'tonic' clang. We pass from first to last note, from tonic to tonic clang, through clangs whose overtones are partially identical; so that a continuity of movement is secured, similar to that which we have explained by the persistence of sensation, as after-image or memory, in tactual and visual movement (§ 46).

The semitone is not by any means the least difference of pitch that the ear can discriminate (§ 13). But it is the least difference which the voice can sing with any accuracy; and we have seen that the larynx is the earliest musical instrument. The singing of two successive semitones, then, means a just noticeable adjustment of the laryngeal muscles, a just noticeable difference of two complexes of strain sensations. The musical scale was formed not by ear, but by voice; and this is one of the reasons why music uses so few of the tones.

Weber's law tells us that equal differences of sensation correspond to relatively equal differences of stimulus. Whether the vocal cords are slack or tense, therefore, their tension must be increased in the same proportion, if we are to get a just noticeable difference of strain sensation, *i.e.*, the difference of a semitone in the vibration rates of the cords. Hence we should expect to find what is actually the case: that as the ♯c has 36 vibrations in the second when the c has 32, it has 72 when the c has 64, 144 when the c has 128, and so on.

A melody is, in the second place, a succession of rhythms. It consists of a number of measures, rounded to phrases and periods. The rhythm helps to hold the changing clangs together, as the melody proceeds; and the return of melody to its tonic clang helps to hold together the series of rhythms.

We have in a given melody, then, a qualitative whole in a temporal setting. The melodic idea is more complex than those which we have discussed hitherto. It lies on the border-line between an idea and a successive association of ideas.

§ 51. **The Function of the Idea.** — Two of the questions of § 43 have now been answered: we have seen how ideas are formed, and which of the four attributes of sensation are of the greatest importance for their production. We have not yet answered the third question, — under what circumstances the idea acquires its unity or singleness for mental experience.

Not every sensation complex has this unity or singleness; so that not every sensation complex can be termed a perception or idea. The visual quality of yellow and the tonal quality of the middle *c* may be together in consciousness. Yet there is no yellow-*c* or *c*-yellow idea. On the other hand, not every complex of sensations which can be called unitary or single can also be called a perception or idea. The experiences of drowsiness, fatigue, health, etc. (§ 21) are complexes of sensations and affection closely connected; yet we should hardly speak of them as perceptions or ideas. Despite their singleness in experience, we term them groups of organic sensations, or, less accurately, organic sensations. The unity or singleness of the idea must, therefore, be of a special kind and result from special conditions.

The idea is unitary because it is the conscious representative of a single object or process in the outside world. It is a complex of elementary mental processes which, in its entirety, corresponds to the various aspects or phases of a physical object or process. The object or process appeals to us in different ways, by different sense channels; and each kind of appeal is represented in the idea. The reason for its singleness, its self-consistency, is, therefore, a biological reason: what the organism finds together in the world in which it lives, remains together

in perception or idea. The physical processes underlying the visual quality yellow and the auditory quality *c* are not connected together, and consequently the qualities themselves cannot join to form an idea.[1] On the other hand, the qualities corresponding to the organic, bodily processes underlying health, etc., are never found apart, and their analysis is very difficult. Hence they are ordinarily regarded as sensations. When analysed, however, the complexes prove to correspond to *different* physical processes at *different* parts of the body. Hence to the psychologist they form a group of sensations, not an idea. Different from both the yellow-*c* complex and these complexes of organic sensations is the simple clang, or note. Here the qualities are so closely blended that the whole is popularly regarded as a sensation. When analysed, it falls into a number of constituents; but these all correspond to the various phases of one physical movement-process,—and the clang is accordingly a true perception or idea.

We are now in a position to understand why there should be those conflicts, between ideas derived from different senses, of which we have more than once spoken (§§ 44 ff.). Although all the sense-organs are in the service of the same organism, each of them mirrors or reflects the objects and processes of the physical world in its own special way. As the senses stand upon different levels, some being more and some less highly developed, discrepancies must necessarily arise when two of them furnish the same kind of idea. The appeal is always to vision, — to the most

[1] A correspondent informs me that he *has* an idea of 'yellow-*c*.' The middle *c* of the keyboard of an old piano, upon which he played as a child, had changed with much use from its original white to a deep yellow. He was accustomed to 'find the *c*' by colour, and has ever since associated yellow with the quality of the *c*, for which he possesses an absolute memory. — This experience affords an excellent illustration of the principle laid down in the text.

highly developed class of four-attribute sensations. "Seeing is believing."

The ideas which conflict with visual ideas, and which for that reason we refuse to accept, are termed *illusory* ideas. They are deceptive ideas, ideas which 'play' with us. If two blunt points are set down upon the skin of the back at a distance of 60 mm. apart, they are taken to be but one impression, *i.e.*, tactually localised at the same place. This tactual idea of locality is illusory; we have only to see the stimuli to believe that they are two. — Draw a pair of compasses, whose points are 2 cm. apart, across the face from ear to ear, so that one point travels over the upper lip, and the other between lower lip and chin. Your tactual idea of the figure described will be that of an oval. The points seem to come together at the ears, where you cannot localise impressions accurately, and to separate at the lips, where your power of localisation is greater. This idea of an oval is illusory: sight would tell you that the compass points are describing two parallel lines. — The size of the cavity of a hollow tooth, as perceived by the tip of the tongue, is illusory, as are also the differences which the skin perceives in the rate of a movement known by the eye to be uniform. — If as we lie upon the tilt-board the strain and pressures in head and neck and back tell us that we are standing upon our head, and we then open the eyes and 'see' that we are only 60° from the horizontal, we reject the tactual idea and accept the visual. The former is illusory.

Yet we are often deceived by the eye itself, and know that we are deceived. In such cases we speak, not of a visual perception or idea, but of an *optical illusion*. Thus the eye declares that the railway lines along which we are looking meet at the horizon, and that a square figure is higher than it is broad. The eye, that is to say, is, no more than the skin, an absolutely reliable mirror of external objects and processes: if we did not know that the lines are parallel and that the square is equilateral, the eye would deceive us.

Figure 8 gives instances of optical illusions in the sphere of extensive ideas. The two cross lines in *a* seem to be parts of one and the same line. This is not the case; so that we have in the figure an illusion of position. In *b* a square is inscribed in a

circle. But the four arcs appear to belong to smaller circles, and the sides of the square to bend inwards; so that the figure seems to be of the same type as *c*. We have in it an illusion of form.

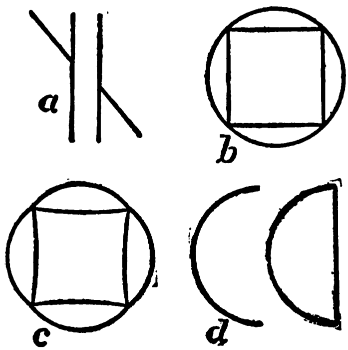


FIG. 8.

The open semicircle in *d* looks larger than the closed. Both are of the same size: the figure gives us an illusion of magnitude.

The first of these illusions is the result of two factors. We always overestimate vertical distances, because it requires more effort — the strain sensations must be stronger — to move the eye up than to move it out or in. Hence the left-hand cross-line is put too high in our idea, and its continuation accordingly looked for at too high a point on the right of the rectangle. We also overestimate the size of small angles. Since the acute angle made with the rectangle by the left-hand cross-line is overestimated, the continuation of the line on the right will again be looked for too high up. — The second illusion also depends on the fact of the overestimation of small angles. The angles made by the sides of the square with the four arcs are regarded as larger than they really are. The illusion necessarily follows. The overestimation itself is probably due to the passing of the eye along the lines forming the angle, and the consequent forcing-apart of those lines in perception. — The third illusion is accounted for by the fact that the open semicircle offers no impediment to eye movement, while the closed figure seems to check it above and below.

We have a visual illusion of movement from what is called the stroboscope. A series of instantaneous photographs of some moving object, *e.g.*, a flying bird, are taken in rapid succession. These are pasted at regular intervals on the inside of a cardboard cylinder. In the wall of the cylinder, above the photographs, are cut a number of narrow vertical slits, each one directly opposite to one of the pictures. Twirl the cylinder round, while you look

down through the slits at the photographs. You will see, not the separate phases of the flying movement, but a continuous flight. The reason is, that each impression persists for a little time after the stimulus has passed by.

In all these cases, vision is the test of vision; we know from the eye that the eye has deceived us. We soon learn by experience that the appearance of objects in the field of vision alters as the position of the eyes alters; the table that looks square from one point of view seems to be trapezoid from another. Hence it becomes necessary, for practical purposes, to construct an ideal or standard eye, and to accept its verdict in all cases where the real eyes leave us in doubt, or where two actual visual perceptions contradict each other. The ideal or standard eye is the *measuring* or mathematical eye; the eye that perceives distances and sizes and forms in terms of yards or metres, and directions in terms of angular distance from some fixed point or line. The measuring eye abstracts from all the varying conditions under which an object is seen, and perceives it always under standard conditions. Where we stand the railway lines are 4 ft. 8½ in. apart; if we walk to the point where the horizon lay, they are there too 4 ft. 8½ in. apart: therefore they do not meet at the horizon. The square looks higher than it is broad; but the height is 1 cm. and the breadth 1 cm.: therefore the figure is equilateral.

References for Further Reading

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CHAPTER VIII

The Association of Ideas

§ 52. **The Nature and Forms of Association.** — Our discussion of the perception or idea has brought us face to face with concrete facts, with actual items of mental experience.

But although the idea is an item of experience, and may thus be regarded as complete in itself, it is not a 'thing,' definite in outline and impermeable to outside influences. Looked at from within, it is a complex of fluid processes. Even the most clear-cut idea, the idea of a 'thing,' gives evidence in support of this statement: its centre of interest, the part-process in it which holds the attention, is constantly changing (§ 2). Looked at from without, it is itself a fluid process; a process of varying extent and varying form, set in the midst of a tangle of similar processes, *i.e.*, of a consciousness.

In § 9 we compared consciousness to a fresco; it is a whole in which there are no breaks, but a smooth connection of part with part. The comparison will be useful to us now, as an aid to our understanding of the nature of the idea. The idea is, in one sense, something by itself, complete in itself; just as the figures in the fresco are, as human figures, complete in themselves and separable from the rest of the painting. But the idea is, in another sense, incomplete; it is never found alone, out of its mental setting; it runs over into other ideas. And the figures in the fresco are also incomplete, gaining their full significance only

as parts of the painter's total conception, while their outlines are not sharp and rigid, but merge in their background at the same time that they stand out upon it. The figures imply the whole fresco: the ideas imply the whole of consciousness.

It is natural, then, that the connection of elementary processes should not stop short at the idea. Just as the sensations which are set up at the same time by the excitation of different bodily organs, or of different parts of the same organ, unite to form an idea or perception, so do the sensations which have entered into different ideas or perceptions unite to form still more complex processes, still larger sections of mental experience. And just as we passed from the consideration of sensation to that of perception or idea, so we must now pass from this to the consideration of what is called the 'association of ideas.'

Suppose that I am sitting in my study, and find my train of thought suddenly interrupted by the perception of a loud rumbling noise. The perception may be the whole of the experience: I may feel a momentary impatience at the interruption, and then return at once to my work. But, on the other hand, the perception may call up in my mind the vague picture of some heavy vehicle on the street below my window; and if, earlier in the day, I have seen a traction engine somewhere in the neighbourhood, this visual picture may be made definite, and further connected with the verbal idea 'traction engine.' There is no appreciable lapse of time between the original sound perception and the appearance of these other ideas: the noise is no sooner heard than picture and word are together with it in consciousness. In such cases we speak of a *simultaneous association*.

This, again, may be the whole of the experience: with

the completion of the simultaneous association I may return to my work. But the interruption may go still farther. The idea of the traction engine may arouse in my mind the picture of an accident that I witnessed some years ago, — the quick turn of a similar engine round a sharp corner, the sideward spring of a horse, startled by sight and sound, and the overthrow of the carriage. This in turn may give place to the picture of the man who jostled me as the crowd ran towards the scene of the mishap. And so the process is continued. 'He was curiously like Jones: I have not seen Jones since I was at school: the first time I saw him there he was eating sandwiches on the library table: I always said that there was no use in letting those books stay in cloth bindings: that reminds me, — I had better get my magazine sets bound before they cost too much: all the same, I don't like to spare those articles of Brown's; I shall want them for — ah! all this waste of time over that absurd traction engine!' Every one will be able to parallel this series of ideas from his own experience. It is an illustration of the second form of the association of ideas, *successive association.*

1 The phrase, 'association of ideas,' is doubly misleading. In the first place, it is not *ideas* which 'associate,' but the elementary processes of which ideas are composed. And secondly, the connection is not well described by the term 'association,' which implies a mere juxtaposition of things which remain, after they have been placed together, precisely what they were before.

The expression has come down to us from a psychology which did regard ideas and their connection in the way indicated: which took the idea of a pen or an inkstand to be something just as stable and clearly outlined as the pen or the inkstand itself, and looked upon the 'association' of the two ideas as a mechanical

attachment of one bit of mind, one independent experience, to another. Although this theory is not held to-day, the phrase has gained such wide acceptance that it can hardly be banished from our psychological vocabulary.

§ 53. **Simultaneous Association.** — Our first aim must be to get a clear understanding of the difference between the idea, or perception, and the simultaneous association of ideas. We shall do this most easily if we notice, first of all, the points in which the two processes are alike, and only after these are defined proceed to define that in which they differ.

(1) As regards the elementary processes contained in them, no hard and fast line of distinction can be drawn between the perception or idea and the simultaneous association of ideas. Both prove, when analysed, to be complexes of sensations. From this point of view the idea of an arm-chair (§ 43), which contains both visual and tactual elements, might just as well be described as a simultaneous association of those elements; and the association of visual picture and word in the instance of the traction engine, given in the preceding Section, might just as well be called a complete or perfect idea of the traction engine. If the two processes differ at all in composition, the difference is that the idea is simpler, contains fewer elementary processes, than the simultaneous association of ideas. But this rule has so many exceptions that we cannot safely follow it in distinguishing them.

(2) Nor do the idea and the simultaneous association of ideas differ as regards the way in which their component processes are connected, grouped together in consciousness. The elements of taste, smell, touch and sight which are contained in the idea of lemonade are 'associated' in that

idea, the elements of pressure and vision, or of pressure and audition (verbal local sign), which are contained in the tactual idea of locality, are 'associated' in that idea, — just as, again, the visual picture and word are associated in our instance of simultaneous association. If the two processes differ at all in the connection of their elements, the difference is that the elements in the idea are more closely and invariably associated than the elements of the simultaneous association. But this rule, again, has many exceptions. The elements of touch and vision in the idea of an arm-chair are not more closely connected with each other than with the verbal idea 'arm-chair.' Yet touch and vision together give us an idea; the same elements *plus* the verbal idea, a simultaneous association of ideas.

(3) The difference between the two processes, then, lies neither in the part-processes which they contain, nor in the manner in which these components are grouped together. It must be sought elsewhere. Put briefly, it is this: that the elementary processes in the idea are processes which have never before been in connection with others, whereas the elementary processes in the simultaneous association of ideas have already played a part in some idea. The idea is the concrete mental process which stands nearest to bare sensation: it is in the idea that the organism makes its first conscious adjustment to the natural world. The difference between the sensation which has not, and the sensation which has, taken part in this conscious adjustment is not a difference of quality or intensity, extent or duration. It is only that the one is raw material; the other the same material after it has been turned to account by the organism for some practical purpose. The one means nothing: it does not acquire a

meaning until it has entered into an idea; for it is not the bare sensation, but the idea, which corresponds to an object or process in the physical world, and signifies this object or process to the organism. The other is significant: it brings a meaning with it, because it has, at some time or other, formed part of an idea or perception, *i.e.*, of the conscious representative of a physical object or physical process. The sensation which has been associated in the past, is ready to fall anew into associative connections; the sensation which has never been associated, has to find its place, so to speak, in the course of experience. Or again: the sensation which enters into an idea is the sensation which we obtain by scientific analysis, the independent simple process of Chapter II; the sensation which enters into a simultaneous association of ideas is the sensation as we get it approximately in laboratory experience (§ 17; *cf.* § 74), a process which has a habit, a liability to connect with other sensations in the future, as it has connected before.

Two forms of simultaneous association are of especial interest. As they are at the same time typical of simultaneous association in general, we may confine our discussion of the process to them.

(1) When once an idea has taken shape,—whether it be the idea of locality or of rhythm, of form or of melody,—it is henceforth at the disposal of consciousness as a whole, as a total process. There is no need of its conscious re-formation. However slowly we may have learned the fact that objects lie in space at a distance from us, and however many mistakes we made before the idea of distance was fully formed, we now have it as part of our mental furniture, ready for use upon all occasions. And

the same is true of all the kinds of idea discussed in the foregoing chapter.

It will often happen, then, that when an impression, a complex of stimuli, is presented to the organism, the appearance of the corresponding idea in consciousness arouses some one or other of these available ideas, which joins with the given idea and supplements it. The perception or idea, itself significant of some external object or process, is thus set in its proper place in our conscious plan or map of the physical world; it is arranged among our existing stock of perceptions or ideas, and brought into connection with them. In such cases we speak of the *associative supplementing* of an idea. Associative supplementing is the first sub-form of simultaneous association.

Let us take, by way of illustration, our idea of the distance of an object from our own body. This idea was originally formed from sensation processes, whether sensations of strain from the muscles of the eyeball, or retinal sensations, or both together (§ 44). As bare sensations, these processes were meaningless; they acquired significance only when combined in the idea.

But when we are judging distance, in adult life, we are not concerned to notice the formative sensations of the original distance idea. An object is before us, and our perception of it as an object is at once associatively supplemented by the idea of its distance. Thus (1) if the object is small, we regard it (other things equal) as remote: the smaller a thing looks, the farther off must it be. The idea of size is here associatively supplemented by that of distance. (2) If the distribution of lights and shades upon the surface of the object is of a certain kind, its perception is supplemented, in just the same way, by an idea of distance. A theatre stage may be made to appear much deeper than it really is, if the lights and shades are skilfully distributed upon back-scene and side-pieces. (3) If the object is indistinct, its outlines blurred, the idea of remoteness comes up at once to supplement it. The

less clear a thing is, the farther off is it, other things equal. (4) If there are a large number of objects intervening between ourselves and the object at which we are looking, the idea of remoteness is again associated to it. (5) And if, as we pass rapidly through a landscape, *e.g.*, as we sit in a railway carriage, an object flashes quickly by us, we know at once that it is near; if it glides by slowly, we know that it is distant. The perception is associatively supplemented, so that it makes way for a simultaneous association of ideas.

So close is the connection in these cases between the given idea and the idea which supplements it, that we are apt to lose sight of the way in which this supplementary idea was originally formed, and to look upon it as the direct consequence of the other. Really, of course, the supplementary idea must have previously taken shape, — or it could not now be associated to the given idea. We could not say: "See how clearly the trees stand out upon that hill! It can't be more than two or three miles off" unless we had the idea of distance at our disposal, before we noticed the clearness of the impressions. Clearness of outline is one of the original factors in the idea of form (§ 45); it is not a factor in the idea of distance. The exclamation involves an association of two ideas, of form and of distance.

There is no department of perception which does not furnish instances of associative supplementing. We perceive at once that a drawing in perspective is intended to represent an arrangement of objects in tridimensional space. We accept the rough brush-marks of a theatrical background as an adequate representation of a landscape. — How little we actually hear of what is said to us is shown by the difficulty which we find in understanding a conversation in a foreign language, with which we are familiar only in its written form. We must wait till we are able to supplement the sounds heard, to supply by association the slurred and abbreviated syllables which the ear does not 'catch.' — When we are 'feeling' our way across a room in the dark, and come into contact with a hard object, we say at once: "That is the table!" The tactual perception, incomplete as it is, calls up a visual idea and its verbal expression. — The scent of sandalwood is supplemented by the

visual idea of a glove box or stamp case of sandalwood inlaid with ivory; the smell of roasting meat by the visual picture of the 'laid' dinner table; and so on.

Example

Method. — One of the commonest instances of associative supplementing is the right reading of words wrongly spelled. Even a practised proof-reader may overlook mistakes in very familiar words (§ 42). On the other hand, the misprints in a book which is written in a language not so familiar to us as our own attract our attention at once. We read English by general impression, supplementing what we see as we glance quickly over the printed words; we read German or French more accurately, because more slowly and toilsomely.

These facts suggest a method by which the conditions and attributes of associative supplementing may be investigated. Let an assistant prepare a number of cards, upon each of which is written a one-syllable word, more or less misspelled. For *stage*, *e.g.*, he might take the following: *siage*, *siaye*, *seaye*, *seaue*, etc. Series of, say, ten cards are formed. The larger part of these have misspelled words: *siage* (stage), *worh* (work), *qtace* (place), etc. To avoid the expectation error, however, one or two rightly spelled words must be included in each series. You are shown the ten cards, one at a time, for .2 to .5 sec., and required to read what is written on them.

To get at the *conditions* of the association in these cases, you must subject your results to a careful analysis: noting whether the familiarity of the word has anything to do with its supplementing, whether its form is of importance, whether first or last letters, vowels or consonants, long or short letters, etc., are most easily supplied.

The *attributes* — extent and intensity — of the association can be determined by the assistant, if enough experiments are made. Thus, by varying the amount of the misspelling, as in the instance of *stage* given above, he can discover how extensive the alteration of the word may be, and yet be overlooked by the eye, — how many letters may be wrong while the word is still read aright by association. He can further determine the *intensity* of the supplementing, either by questioning you closely as to the vividness of

the letters which you say you saw, or by increasing the time of exposure till you are just able to read the misspelled word correctly, that is, till the peripheral impression just outweighs the central supplement. The latter is the more reliable method. The quality of the associated ideas is always that of the given impression: black letters on a white ground. Their duration can hardly be made out.

Auditory Localisation. — Some of the most striking instances of associative supplementing are afforded by the localisation of sounds. Sensations of tone and noise possess no spatial attribute, and our auditory perceptions cannot be arranged in space, as visual and tactual perceptions can. When we localise sounds, we do so by indirect means, by the help of secondary criteria. The auditory perception must be supplemented by other ideas.

Our idea of the *direction* in which a sound comes to us is based partly upon tactual sensations, proceeding from the skin and muscle of the external and middle ear, and partly upon the differences in the intensity of the sound, as it is heard by the two ears. A sound which comes from the right will evidently be louder to the right ear than to the left; while the impact of air-waves upon the right pinna will be the stronger, and the adjustment of the right tympanic membrane the more noticeable. Our idea of the *distance* of the sound is an idea of the distance of the source of sound, *i.e.*, a visual or tactual — not auditory — idea of distance.

Method. — Seat yourself in a chair, and let an assistant chalk upon the floor a circle of 1 m. radius, whose centre is the centre of the imaginary line joining your two ears. The circumference of the circle can easily be marked off into 72 parts, *i.e.*, into units of 5°. Close your eyes. The assistant tests the accuracy with which you can localise sounds coming to you from different directions by holding a stop-watch, on a level with your ear, at various points of the circumference of the circle. Having taken up his position, he touches you upon the hand with a rod, and starts the watch. You hear its ticking, and point with another rod in the direction from which you think the sound comes.

If you close one ear with cotton-wool, you will find that your mistakes will be much larger than they are when both ears are open. You have no longer the different intensities of the ticking, as heard by the two ears, to guide you in localising it.

It is always easier to say whether a sound comes from the right or the left, than to say whether it comes from in front or behind. In the first case you have different tactual sensations and different intensities of sound in the two ears to assist your judgment; in the latter you can judge only from the absolute intensity of the sound. A sound in front is generally louder than a sound behind, because it is caught by the pinnæ, and reflected into the ear-passages. Hence if you tie your ears back, by a piece of tape, and place your two hands in front of the ear-passages, the palm facing backwards, you will find your ordinary judgments of 'before' and 'behind' reversed. The two hands act as two pinnæ; but being turned in the opposite direction, they catch sounds coming from behind, and reflect them into the ear-passage, while they cut off sounds coming from in front. What before was loud, and therefore in front, is now weak, and therefore behind, and *vice versa.*

Our idea of the distance of a sound is accurate only when the source of sound is familiar, when we know by experience how far off the body must be to give rise to the sound which we hear. If the perception is unfamiliar, we may make ludicrous mistakes.

(2) The other form of simultaneous association — a form of extreme importance in the adult consciousness — is *word association.* The verbal idea contains both extensive and qualitative elements: in its most perfect form it consists of an auditory complex, a mixture of clang and noise (word heard), a strain complex due to the adjustment of larynx and mouth necessary for the emission of a particular sound (word spoken), a visual complex, a written or printed form (word seen), and the strain complex due to the adjustment of hand and fingers necessary for the pro-

duction of this form (word written). The part played by the verbal idea in consciousness, under one or more of these four aspects, is always large, although its actual range differs with different mental constitutions (§ 35).

The verbal idea serves two purposes in simultaneous association. It may arise before associative supplementing is at an end. In this case, it aids materially in the supplementing, — sometimes, indeed, rendering all further supplements unnecessary. Or it may arise just as the supplementing is concluded, and clinch the association, putting the seal of finality upon it. In the latter case, it is oftentimes difficult to say whether the process is a simultaneous or a successive association.

The verbal idea of a given consciousness does not contain all four elements (word heard, spoken, seen and written) in equal proportions. It resembles the note rather than the chord; one constituent predominates in the complex. Sometimes the sound heard is all that comes to mind: more often the word as heard and spoken. If the visual form is aroused, it nearly always brings the auditory idea with it. The writing-complex hardly ever occurs without the visual form, and therefore hardly ever without the auditory idea also. In every case, some one of the four components is predominant.

Method. — To test the power of the verbal idea as an aid in associative supplementing, a method may be followed similar to that described in the previous paragraph. Rough drawings, mere hints of the objects which they are intended to represent, are prepared. A word is called out to the subject, and then one of the drawings shown him, — a drawing of something closely related to the object denoted by the word called out. He supplements the drawing, by help of the verbal association, and so 'sees' a great deal more than is actually upon the cardboard.

Or the original method may be followed still more exactly. Let us suppose that the extent of associative supplementing has

been determined, by means of a series of misspelled words. Similar series are again presented to the subject; but before each word is shown, a word related to that which the complex of letters is intended to represent is called out. Associative supplementing will go much farther than it did before. Without the verbal association, *siaye* may have been the most mutilated impression which could be read as *stage*. But if consciousness has been given the right direction by the calling out of the word 'theatre,' a form like *aioye* may be supplemented to *stage*.

Instances of the power of the verbal idea to clinch or cement associative supplementing will be readily furnished from the reader's own experience. A striking illustration is that of the recognition (§ 70) of a friend, who has not been seen for some time, and whom one meets unexpectedly. The visual picture is supplemented by a number of ideas (ideas of past meetings, their circumstances, etc.); but the recognition does not become absolute and final until the phrase: "Why, it's Brown!" has come to one's lips or mind. It can be shown experimentally that those objects are best remembered and most easily recognised which can be denoted by specific names (§ 73).

Illusions. — Just as we have illusory ideas, ideas which represent an object or process of the physical world in a way which the measuring eye cannot accept, so do we have illusory associations of ideas. A given impression is supplemented, or calls up a verbal idea, under certain conditions; when these are reduced to standard conditions, the association proves to have put an erroneous interpretation upon the impression.

It is frequently impossible to disentangle, with any degree of certainty, the two possible factors in a particular illusion. It may be due to the structure or mode of working of a sense-organ: then we have an illusory perception or idea in the strict meaning of the phrase. But the illusion may also be due to associations. Take, for instance, the two semicircles of Fig. 8. The closed figure may suggest a strung bow, and the open an unstrung bow; and the illusion of their difference may result from this associative supplement, and not directly from eye movement. Or take the

apparently simple illusion of the greater height of a square figure. This overestimation of the vertical lines may be due to the difficulty of eye movement in the upward direction. But it may also be ascribed to associative supplementing. The square is not broad-based enough to suggest a block of stone lying upon the ground; that which is to give us the idea of rest must be longer than it is high, — must resemble the prostrate figure of a man. The square seems to be striving upwards, to be raising itself, and to be 'holding itself together,' squeezing itself in, in the effort.

Stroboscopic illusions, again, might be occasioned by the persistence of after-images, without any associative supplementing of the photographs. But they are greatly assisted if we have a clear idea of the sort of movement which we are going to see, before we look through the slits in the cylinder.

But while many illusions can be regarded either as illusory ideas or as illusory associations of ideas, there are some which undoubtedly have their source in association alone. Thus, the sun and moon look smaller to us when they are directly above our heads, at the zenith, than when they are in front of us, at the horizon. It is difficult to see any reason for this illusion in the structure or function of the eyes. On the other hand, (1) the outline of the discs is more distinct at the zenith than at the horizon, because there is less air between them and us, and what there is is clearer, less misty and smoky. Hence they seem to be nearer. And (2) there are many objects — trees, houses, hills — between ourselves and the horizon; none between us and the zenith. Again, then, the bodies seem to be nearer. But if a nearer and a remoter object occupy the same space in the field of vision, the former must be smaller than the latter.

The same holds of certain illusions which involve qualitative ideas. The ventriloquist 'throws' his voice into some inanimate object at a distance from him. To produce the illusion at which he aims, he keeps his lips as far as possible unmoved during articulation, raises or lowers his voice beyond its natural speaking pitch, and looks steadfastly at the object to which he wishes the sounds to be referred. The listener knows that he is being deceived; but the illusion may be so complete that it cannot be

wholly destroyed except by the visual perception that the muscles of the performer's throat are twitching, although his lips are still.

Illusions of melody are similarly produced. When we are waiting for the passage of a circus procession, we 'hear' the music of the band in the distance many times over, before it actually comes within the range of audition: some chance sound is associatively supplemented, and so takes the form of a familiar melody.

§ 54. **Successive Association.** — We found only a single difference between the idea or perception and the simultaneous association of ideas: the difference that the elementary processes contained in the idea had never before been connected with others, while the elementary processes contained in the simultaneous association had already played a part in some idea. The same difference holds between the idea and the successive association of ideas. But there is a further distinction, which enables us to mark off the successive association both from the idea and from the simultaneous association, — the distinction which is expressed by the word 'successive.' We cannot indicate any stages in the formation of the idea; when certain conditions, physical and mental, are realised, the idea emerges, takes shape at once. Nor can we indicate any stages in the formation of the simultaneous association; we no sooner hear the noise, than the visual picture of the traction engine comes up; there is no 'before' and 'after' in the experience. In the successive association, on the other hand, there is a clearly marked division of the whole process into stages; an idea arises, and *then* another idea is connected with it.

There are two principal forms of successive association: the *train of ideas* and *association after disjunction*. The

former corresponds to the associative supplementing, the latter to the verbal association of § 53.

(1) In the *train of ideas* we have a continuous series of processes, idea following idea along the line of least mental resistance, without restriction of any kind. Ideas come and go, as they come and go in the 'inattentive' consciousness of the child or the animal (§ 40); there is no concentration, no converging of tendencies; consciousness is conditioned by the accidents of the moment. This form of successive association appears whenever we fall into a reverie, or grow drowsy, or give ourselves up to the influence of our surroundings, — setting out on a country walk, *e.g.*, with all thoughts of the routine of daily occupation banished from our minds.

Method. — The course which the train of ideas follows in different consciousnesses may be tested by experiment. Series of words are prepared, care being taken that the words forming a particular series differ as much as possible in meaning and character; thus, two verbs should not be placed side by side, some substantives should be abstract and some concrete, etc. The words may be printed on cards, which are shown to the subject in succession, or may be merely pronounced by the experimenter; in the former case the time of exposure must be kept constant and must be short, — say, about 2 sec. After each word has been presented, a pause of some 10 sec. is made, during which the subject writes down the ideas which the word has suggested to him, *i.e.*, which have been associated to it in his consciousness in the 10 sec.

The experiments may be made individually, upon a single subject, or collectively, upon a number of individuals. In either case, the results must be carefully analysed, at the conclusion of the series, by experimenter and experimentee. The subject must go over his list of written associations, noting (1) the sense department from which each idea was drawn, (2) the period of

life to which it belongs, and (3) the idea which suggested it. The experimenter must then, in his turn, work over the list, noting (1) the relative quickness and readiness of association in different individuals, or in the same person under different circumstances, and (2) the various kinds of association involved, — the association of one general or particular idea to another (co-ordination), of a particular idea to a general (subordination), and of a general idea to a particular (superordination).

Suppose, *e.g.*, that the first word of a printed series was the word *horse*. One list of associations, within the 10 sec., might read as follows: *horse*, *Prince*, *heels*, *stable*, *straw*, *cow*, *dog*. The subject would analyse this list, at the conclusion of the series of experiments, somewhat in this way: —

(1) *horse:* auditory idea; present time; suggested by the written *horse;* a simultaneous association (verbal association):

(2) *Prince:* mainly visual, idea of a particular horse; childhood; suggested by *horse* (successive):

(3) *heels:* mainly visual, idea of a particular incident connected with *Prince;* childhood; suggested by *Prince* (successive):

(4) *stable:* visual and olfactory; childhood; suggested by *Prince* (seemed to arise simultaneously with *heels*):

(5) *straw:* visual; childhood; suggested by *stable* (successive):

[here the train of ideas switched off from the *Prince* associations, and the original idea (visual and auditory) of *horse* came to mind:]

(6) *cow:* general idea, auditory (verbal) and visual; no time reference; suggested by *horse* (successive):

(7) *dog:* general idea, auditory (verbal) and visual; no time reference; seemed to be suggested by *cow*, though possibly due to *horse*.

He would also, if he were skilled in introspection, jot down a large number of nascent, interstitial ideas, — 'marginal' associates, clustering around the 'focal' ideas of the list. These imperfect ideas are important, both as emphasising the *process*-nature of the

train of ideas and as throwing light upon mental constitution.— From a large number of series, worked over in this way, we can discover how much the different sense-organs contribute to the furnishing of a particular mind with ideas, how observant and retentive the mind is, and how far it is accustomed to pursue a single topic without allowing itself to be interrupted by irrelevant ideas.

The experimenter now takes the same list, and notes that *Prince* is a particular idea associated to a general idea, *horse* (subordinate); that *heels*, in the same way, is subordinate to *Prince;* and that *straw* is subordinate to *stable*. The three ideas of *horse*, *cow*, and *dog* are co-ordinate. The relation of *stable* to *Prince* is doubtful: the two may be co-ordinate, or *stable* may be superordinate,— the home of a series of particular horses. By calculating the proportions of the three types of association in a large number of experiments, the experimenter can ascertain the way in which the subject ordinarily thinks, *i.e.*, his intellectual constitution (§ 35). He also notes that in this case there were seven focal ideas (*Prince*, *heels*, *stable*, *straw*, *horse*, *cow*, *dog*), and so or so many marginal ideas aroused in the 10 sec.

(2) *Association after disjunction* consists, as its name implies, in the coming together again of ideas which were originally together, but have somehow become separated. The best illustration of this form of successive association is the connection of auditory ideas in the sentence. The whole 'thought,' *i.e.*, complex of ideas, which the sentence expresses must form part of our consciousness, however vaguely, before we begin to speak; otherwise we could not carry the sentence to its conclusion without hesitation and mistake.

The disjunction is due to the attention; the rejoining is a successive association. Suppose that I say to myself: "That chord contains the notes *c*, *e*, *g*!" The chord is given as a total impression; it is a complex of simultane-

ously sounding tones. But the attention fixes for some reason (§ 38) upon one of the constituent tone complexes, the note *c*. This is rendered prominent and distinct, while the remaining constituents are blurred and weakened. The impression is thus split up, its components dissociated. The attention soon relaxes from its first object, and the other two notes receive, in turn, their share of notice. The whole complex is thus reviewed, part by part, and put together again in the sentence: "It contains the notes *c*, *e*, *g*."

The successive association in this and similar instances has the character of completeness or finality (*cf.* the verbal association of § 53). The 'thought' is complete when a certain number of words have been uttered; the chord is done with when the three constituent notes have been re-associated; the melody is complete when a certain number of chords have sounded. The finality is a necessary consequence of the fact that the association is based upon a foregoing dissociation; the whole is given before its parts are discerned; the associative process comes to its natural end when the dissociated parts have been put together again. The train of ideas, on the other hand, is absolutely lacking in finality; it never dies a natural death, but must be violently interrupted, if it is to come to a conclusion.

It must not be supposed, however, that the association after disjunction is a mere putting together of what has been pulled apart, of the original raw material. The attention, in singling out some factor in the original complex, renders it more prominent and therefore more liable to be associatively supplemented. The parts which are put together again, by way of successive association, are put together only after they have been modified, worked over, by way of simultaneous association. If I swallow a draught of lemonade, and, finding it very sweet, say: "How sweet this stuff is!" I am not simply putting together sweetness and the other constituent lemonade-processes as they were given

in the original idea. The sweetness has attracted the attention; it has been disjoined from its surroundings, and supplemented by ideas of the right amount of sweetness, by sensations of nausea, etc. We have no longer a single idea, containing the element 'very sweet'; we have two ideas, a successive association of ideas, — the original idea having been followed by the worked-over idea of sweetness. In the same way, the statement of a scientific theory is not a simple re-collection of facts which have been presented together, but separately attended to: it is the re-collection of these facts after they have been associatively supplemented, *i.e.*, referred to their conditions.

Psychologically regarded, all instances of *judgment* fall under this second heading of successive association. Take, *e.g.*, the judgment: "The waste-paper basket is under the table." Here we have an original whole, a visual complex including local ideas of basket and table. The two constituents are disjoined by the attention, and reunited after the idea of position has been made explicit. Or suppose that we walk into a strange village and say: "That must be the hotel!" We have a visual complex, the idea of a certain house, from which the attention dissociates all the hotel-like elements. These are supplemented, and form the hotel idea, which succeeds the original house-hotel complex.

Method. — To test the formation of successive associations of this type, the following plan may be adopted. Show the subject, for a short time, a complex visual impression, — the picture of a street or ceremony or landscape, — an impression, *i.e.*, which is too complicated to be grasped by one pulse of the attention. Let him then write a description of it, trying to reconstruct it as a whole, and putting down his ideas in the order in which they occur to him; that is, in the order in which the various parts of the picture attracted his attention. As he writes, more and more ideas will occur to him; so that the process of reconstruction will take the form of a successive association.

A train of illusory ideas is termed a *hallucination*. Hallucinations do not occur in the normal mind. We have instances of them in dreaming and in the visual phantasies of alcoholic delirium. Illu-

sory judgments are termed *fallacies*, when formed in a normal consciousness; *delusions*, when they appear as a sympton of insanity.

§ 55. **The Law of Association.** — The fundamental law of the association of ideas may be stated in almost the same words as those which we used in accounting for the singleness or unity of the idea. What the organism finds together in the world in which it lives, we said, remains together in perception or idea. But one and the same kind of elementary mental process may be concerned in many different adjustments to physical surroundings, and will therefore have a tendency to connect with processes which form part of many different ideas. This fact is the key to association. *All the connections set up between sensations by the formation of ideas tend to persist, even when the original conditions of connection are no longer fulfilled.*

Let us apply this law to the four cases of association which we have described.

(1) *Associative Supplementing.* — Here we have a complex of sensations, *abc*, some or all of which have been connected, in past experience, with other elementary processes, *xyz*. Hence, whenever *ab* or *abc* appears, *xyz* tends to appear with it.

A rumbling noise, *abc*, is heard. Our idea of a heavy vehicle includes, as part-processes, the noise, *abc*, and a complex of visual sensations, *xyz*. Hence as the noise is heard, the visual complex is aroused also; the noise is supplemented by the other components of the idea of a heavy vehicle.

Or we have the idea of a clearly outlined hill, *abc*. Our idea of nearness, *xyz*, has been connected, in past experience, with the idea of clearness of outline, *ab*. Hence when we see the hill, *abc*, we have at once the idea of its nearness: *ab*[*c*] is supplemented by *xyz*.

(2) *Verbal Association.* — Verbal association takes place in precisely the same way as associative supplementing. The only

reasons for separating the two processes are, first, that the verbal idea is the most important of all the supplementary ideas, — sometimes, indeed, as in the instance of a verbal 'local sign' (§ 44), rendering all further supplement unnecessary, — and secondly, that the verbal association is on the boundary line between the simultaneous and the successive association. (*a*) The word is important because it is, so to speak, the common denominator of all ideas alike; words are the medium by which we communicate ideas to one another, whatever the ideas may be. Hence the verbal idea is the richest of all ideas in habits of connection; it has the greatest tendency to associate, as well as the greatest range of association. At the same time, it is the word which, as the single expression of a complex of sensations, gives definiteness or finality to that complex. (*b*) That verbal association lies on the border-line between the simultaneous and the successive forms of association is shown by the two instances of the traction engine and the hotel. Had the noise been a little less definite in its suggestion, we might have thought for a moment, and come to the conclusion that it was due to a traction engine (successive association). Had the village hotel been a little more definite in its suggestion, a little more clearly a hotel, the word 'hotel' might have arisen in our minds as soon as we saw the building (simultaneous association).

We may refer to our first illustration. The noise *abc* has aroused the visual complex, *xyz*. The words 'traction engine,' which we may represent by *pqr*, have been constantly connected with this visual complex. Hence given *abc*, and we have *abcxyz;* given *xyz*, and we have *xyzpqr*. Given the noise, and we have visual picture and name of the vehicle.

(3) *The Train of Ideas.* — This is easily reduced to the same formula. The written word *horse* is supplemented by the auditory idea of horse; *abc* becomes *abcxyz*. But there are some elements, *x*, common to my ideas of *horse* and of *Prince;* on the one hand I have *abcxyz*, on the other, say, *xdef*. When the former is given, therefore, the latter comes up. But again, there are elements, *f*, common to my idea of *Prince* and to my idea of *stable;* on the one hand I have *xdef*, on the other, say, *fgh*.

When the former is given, therefore, the latter comes up. And so on.

(4) *Association after Disjunction.* — We have a complex, *abcd.* This is divided up by the attention into *ab* and *cd.* The former is supplemented to *abxy,* the latter to *cdpq.* We then have the successive association *ab*[*cd*]*xy* – [*ab*]*cdpq;* the two supplemented ideas associate, because of the association of *abcd* in the original complex. — Or we have the original complex, *abcd.* Some one part-process, *c,* attracts the attention, and is supplemented. We then have the successive association *abcd–cxy.*

The chord *c–e–g* is given. It is divided up into its three notes, and each of the notes is supplemented by a word, the name of the note. The three notes are then associated, the ground of their connection lying in the fact of their having been together in the chord. — Or a hot room is given, and the heat attracts the attention. The heat-idea is supplemented, and this supplemented idea associated to the whole complex.

We can, then, express the law of association by the formula *ab* – *bc.* One idea calls up another when it contains elements which are common to it and that other. Connections once formed (*bc*) tend to persist even when the conditions of their formation are not realised (when only *ab* is given).

All connections set up between sensations by the formation of ideas *tend* to persist. It is the business of psychology to discover under what conditions they actually do persist, — why it is that now this and now that idea is associated to the same impression. The conditions of persistence are partly external and partly internal. On the one hand *frequency* of association in the outside world assures stability of connection in consciousness; on the other, our *mental constitution* decides what shall be the line of least associative resistance. In a given instance, these conditions may vary somewhat: the recency of an occurrence, *e.g.,* may give it the same power of connec-

tion that it would have gained by frequent repetition, and the pleasantness or unpleasantness of an event, *i.e.*, its hold over the attention, may give it the same power of connection that it would have possessed in its own right had it appealed to our specific mental constitution.

Method.—The special conditions of the association of ideas in a particular consciousness at a particular time can be determined only by a careful analysis of experimental results, carried out along the lines indicated in the foregoing Section. At present so few investigations have been made that it is hardly possible to say anything more than has been said, in general terms, in the text. Another method for testing the *quickness* of different associations will be described in Ch. XIV.

In the older psychologies various *laws* of association were recognised: association by similarity, association by contiguity, association by cause and effect, etc. These are in reality not laws, in the true sense of the word, but *sub-forms* of one type of successive association,—the train of ideas. If the association took the form *abcd–bcde*, it was called an association by similarity; if it took the form *abcd–axyz*, an association by contiguity; if *axyz* happened to be the effect of *abcd*, an association by cause and effect.

Thus suppose that the idea of 'Alexander the Great' suggests that of 'Napoleon.' This would have been called an association by similarity. But its formula evidently is: Alexander, general, conqueror,—Napoleon, general, conqueror. There is no new 'law' involved; it is our own law *ab–bc* with the *b* elements preponderant. Or suppose that the idea 'cow' suggests that of 'milkmaid.' This would have been called an association by contiguity. But its formula is: cow, cow in field, cow being milked,—milkmaid, cow being milked. Again, there is no new law involved; it is our law *ab–bc*, with the *a* and *c* elements preponderant.

It is, then, a mistake to speak of these forms of association as 'laws.' The mistake arose from the habit of considering ideas as permanent wholes, 'bits' of mind, which were joined together as wholes. The fluidity of the idea, and all the facts of associative supplementing, were unnoticed.

Very little is known in detail of the *physiological processes* which correspond to the mental processes of association. We know that the more frequently any organ has been in action, the more easily is it set in action; the tendency to act grows with action. We must suppose, further, that the tendency of two parts of the brain to act *together* grows with every instance of *joint* action. The supposition is borne out by what we know of the brain's mode of working. We shall return to the point in § 76.

References for Further Reading

Ebbinghaus, *Grundzüge*, I, §§ 60–64.
James, *Principles*, I, xiv.
Külpe, *Outlines*, §§ 27, 27*a*, 29–33, 67.
Wundt, *Grundzüge*, II, xvii (§§ 1–4).
Consult also: A. Bain, *The Senses and the Intellect*, 3d edn., 1868, H. Münsterberg, *Beiträge*, i, 1889, iv, 1892; G. C. Robertson, art. *Association*, in *Encyc. Brit.*, 9th edn.
See further: B. Bourdon, in *Revue phil.*, 1891; M. Offner, in *Philos. Monatshefte*, 1892; W. Wundt, in *Phil. Studien*, 1891.

CHAPTER IX

FEELING AND EMOTION

§ 56. **The Nature and Forms of Feeling.** — Consciousness can never be wholly affective, to the exclusion of all sensation processes. This can be shown in two ways. On the one hand, consciousness is always complex, consists always of more than one elementary process. But the affection of any particular moment is a single affection; however numerous the stimuli which are presented at that moment, their pleasantness or unpleasantness is one in our experience (§ 32). And as there are no 'mixed feelings,' no simultaneous associations of pleasantness and unpleasantness, there must be something besides affection present to constitute a consciousness. On the other hand, it follows at once from the definition of affection that an affective process cannot be the whole of consciousness. An affection is the conscious representative of the way in which the organism takes certain impressions. But there can be no way of taking unless there are impressions to take, — *i.e.*, unless sensations are set up at the same time as the affection.

Although, therefore, consciousness may very well consist solely of sensation processes, — ideas or connections of ideas which are of such slight intensity as not to excite pleasantness, or of so habitual occurrence as to have become indifferent, — no consciousness is exclusively affec-

tive. Ideas can stand alone, without affection; affection cannot stand alone, without the support of sensation or idea.

The simplest concrete process in which affection preponderates is the *feeling*. The feeling stands on the same level of mental development as the perception or idea; it is in reality a complex process, composed of a perception or idea and affection, in which affection plays the principal part. As a rule, the greater number of the constituent sensations are either indifferent, or but weakly pleasant or unpleasant, while a minority stand out distinctly as the supporters of an intense affection. Thus the feeling that arises when we cut our finger contains visual and cutaneous sensations, which are indifferent; the organic sensation of pain, which stands out above these; and a strongly unpleasant affection, which attaches to the pain. We term the feeling, in so many words, a 'feeling of pain.' And we say in the same way, that we 'feel warm,' 'feel tired,' 'feel thirsty,' 'feel giddy,' etc., naming the feeling in each case from the strongest sensation or group of sensations in the complex.

The strongest sensation, it must be remembered, is not so strong as the affection. The fact can best be shown symbolically. It we denote sensation by s and affection by a, and further employ large and small letters to express different degrees of intensity in these processes, we can indicate the composition of the feeling by the formula ssA.

The compound sS would then be an indifferent perception. We often have, in experience, sSa or sS_A; a complex in which the strongest sensation is stronger than the affection. In such cases, we speak not of a feeling, but of an 'affectively toned idea.' Suppose, *e.g.*, that we cut our finger with a razor. We might be struck, at the moment, rather by the extreme sharp-

ness of the blade than by the pain of the wound. We should then have not a feeling of pain, but an unpleasantly toned idea of sharpness.

Practically, it is not hard to draw the distinction between feeling and affectively toned idea; the two are sufficiently well-marked in actual experience. In scientific analysis, however, they differ only in the amount of their affective constituent; and, as we have no means of measuring this amount at all accurately, psychology can distinguish them only by the general statement that the feeling is more affection than it is idea, the affectively toned idea more idea than it is affection.

We have noticed the fact that impressions which are frequently repeated become indifferent. The organism adapts itself to them, and their pleasantness or unpleasantness 'wears off.' It is an evident corollary to this that the ideas which are of greatest service to us as the sources of knowledge of the physical world, and which are therefore most often 'handled' by us in acquiring or imparting knowledge, are least likely to play any large part in the formation of feelings. They become stereotyped, so to speak; they are attended to not for their own sake, but for the sake of what they mean. They are, as a matter of fact, always in process; their composition varies, and the relative intensity, duration, etc., of their components also change. But we take them for granted, supplementing them as the proof-reader supplements misspelled words (§ 53). And at the same time that we overlook slight changes in their contents, we lose the pleasantness or unpleasantness which once attached to them.

There can be no question of the correctness of this corollary as regards sight and hearing. These two senses are in constant exercise; sight for reading, and hearing for conversation, listening to lectures, etc. We are perfectly indifferent to the great major-

ity of the visual impressions which we receive in the course of a day. It is only when they are too strong, as when snow dazzles the eye, that they are markedly unpleasant; and only by contrast, as 'restful' or 'quiet,' that they are markedly pleasant. It is true that we speak of 'feeling blue,' 'feeling dull,' etc., and say that 'things have a black look.' But these are metaphorical expressions, referring to the promise of bad weather in a lowering sky, etc. — Just the same thing holds of clangs and noises.

But there seem to be important exceptions to the rule in certain organic sensations (not in all: *cf.* §§ 17, 44 ff.), and in the ideas founded upon smell and taste. So far are these ideas from being indifferent, that we ordinarily classify smells and tastes as agreeable and disagreeable, while the organic sensations are merged in the feelings of bodily comfort and discomfort. Yet all three are of frequent occurrence.

The difficulty disappears when we consider the conditions under which the ideas and sensations in question arise. (1) Organic sensations give us knowledge of a very important part of the physical world, our own body; they are set up by some change within a bodily organ, not by any outside stimulus. Now a change in any of the principal organs must stand in intimate relation to the state of the nervous system; and the state of the nervous system, anabolism or catabolism, is the physical condition of affection. Hence if the organic sensations attain to any considerable degree of intensity, we *must* attend to them, and *must* feel them to be pleasant or unpleasant. An organism which could disregard them would have carried its indifference too far, and would quickly perish. On the other hand, if the sensations are weak, they pass unremarked, *i.e.*, are indifferent. — We have here, then, no real exception to the rule. Any intensive impression attracts the attention. The apparent exception is due to the fact that certain organic sensations, owing to the peculiar conditions under which they arise, attract the attention more forcibly and exclusively than do the sensations of sight and hearing. (2) Smells and tastes may become indifferent: the surgeon does not notice the smell of the dissecting room, the gardener the fragrance of the hothouse, the smoker the tobacco-laden air of his study; and those whose

diet is regular take their accustomed dishes day by day without thought of the pleasantness or unpleasantness of what they eat and drink. But smell and taste, like the organic sensations, occupy a peculiar position among the senses. In the first place, they are of extreme practical importance to the organism, standing guard as they do over respiration and digestion. Hence a small variation in a smell-taste complex, anything unfamiliar in a familiar setting, will attract the attention more quickly and forcibly than would a much larger difference in other sense departments. We cannot afford to neglect smells and tastes. Secondly, however, affections are often ascribed to smell and taste which really belong to the organic sensations. Thus, a meal may be very pleasant, despite the accustomedness of the dishes set before us. The pleasantness is in this case a digestive pleasantness, derived from the satisfaction of hunger; but it may very well be referred to the 'appetising' smell and agreeable taste of the meats.

It may be said, too, that smells, tastes and most of the organic sensations, familiar as they are, are not so entirely habitual as sights and sounds. They are not used as symbols for the reception or imparting of general knowledge, as written and spoken words are. Where this is the case, where they are thought-counters which can be passed from man to man, as coin is passed in exchange for goods of all kinds, they lose a large part of their intrinsic capacity to evoke affection. Thus the savage, who uses the sense of smell, much more frequently than civilised man, to gain knowledge of the outside world, is far less affected by the pleasantness or unpleasantness of odours. An attempt has been made, experimentally, to develope a smell-arithmetic; and it has been found that simple additions and subtractions can be performed by the help of smell-ideas alone. If any one were to take the trouble to carry this arithmetic still further, there can be little doubt that the smells employed in it would grow entirely indifferent, — as indifferent as articular pressures.

Touch, as might be expected, stands midway between these two groups of senses. The tactual differences of roughness and smoothness, stiffness and softness, dryness and wetness, etc., prove to be distinctly pleasant or unpleasant, if the attention is directed

to them. Nevertheless, we touch a great many objects in the course of a day with complete indifference.

The feeling is a mixture of perception and affection, in which the affection preponderates. Hence feelings cannot be satisfactorily classified except in terms of affection, the strongest part-process. Now there are only two qualities of affection: pleasantness and unpleasantness; and there are, accordingly, only two kinds or classes of feelings: pleasant feelings and unpleasant feelings. But as very many different perceptions may enter into one class of feelings, there will be many shades or varieties of feeling within each class. Thus the feeling of warmth and the feeling of satiety are both pleasant feelings, feelings of the same kind; but the difference of the sensation processes contained in them makes a difference in the whole feeling. Language, as we have seen, avails itself of such differences; feelings are named after the strongest constituent sensation.

It is often asserted that there are a great number of different feeling qualities; that affective experience is as rich in qualities as sensible experience. It is rather true, as stated in the text, that there are only two qualities of feeling, — the qualities of pleasantness and unpleasantness; but the complexity of sensible experience shows through the affective overlay in the various concrete feelings. The differences between feeling and feeling within each class are entirely due to differences in the quality of component sensations; but as the predominant quality of the whole is an affective quality, these differences are — naturally, but quite wrongly — attributed to affection. The difference between the 'feeling of giddiness' and the 'feeling of suffocation' lies in their sensible factors, not in their affective constituents. They differ as giddiness and suffocation differ: as unpleasantness, they are the same.

We may speak of *illusory* feelings, in the sense that there is an affective contrast observable when feelings of different kinds follow one another in consciousness. Affective contrast must be successive, not simultaneous, since there are no 'mixed feelings.' — If a moderately pleasant is followed by a moderately unpleasant feeling, the unpleasantness of the latter is intensified, and *vice versa*. Very weak feelings do not contrast: there is not enough affection present. And very strong feelings shake the nervous system too violently for contrast effects to be manifested. The criminal, reprieved from death, cannot realise his good fortune at first; he is merely dazed.

§ 57. **The Nature of Emotion.** — The emotion stands upon the same level of mental development as the simultaneous association of ideas. On the side of sensation, consciousness advances beyond the stage of a patchwork of perceptions or ideas; the factors in different ideas run together and form larger wholes, each of which corresponds, not to an object or process, but to what we may call a *situation* or *incident* in the physical world. On the side of affection, consciousness advances beyond the simple feeling to the emotion. The organism does more than 'feel cold' and 'feel unwell': it feels the pleasantness or unpleasantness of a certain total situation or predicament, of the whole complex of ideas which represents a certain concurrence of processes or collocation of objects in the outside world. On the one hand, we have a rumbling noise, interrupted by a shrill scream: these ideas are supplemented by the ideas of a child and a wagon: and the whole complex of ideas suggests at once that an accident has happened. On the other, this accident is felt, in its totality; we have the emotion of pity or of fear.

The conditions under which an emotion arises will, then, be somewhat as follows. We set out with a consciousness

composed of a number of ideas, more or less distinct, and more or less pleasant or unpleasant. This consciousness is suddenly interrupted by an idea to which the attention is forcibly attracted (passive attention). The idea is immediately supplemented by other ideas, and a simultaneous association is formed, reflecting a scene or situation in the physical world. The situation is of such a kind that the organism, in obedience to biological law, must feel it to be pleasant or unpleasant. At this stage we have, therefore, a complicated feeling set in the midst of the original consciousness. The feeling is so powerful, however, that the original processes are now upon the verge of disappearance.

An organism which is called upon to face a particular situation must do so by a particular bodily adjustment, a special bodily attitude or set of bodily movements. This adjustment is taking place at the same time that the complicated feeling, just described, is ousting the processes of which the original consciousness was composed. As it takes place, various organic sensations are set up, — the direct results of the changes in the position, tension, etc., of the various bodily organs involved. These organic sensations associate to the mass of ideas contained in the feeling, and together with that feeling constitute the *emotion*.

It is essential, then, for the formation of an emotion: (1) that a train of ideas shall be interrupted by a vivid feeling; (2) that this feeling shall mirror a situation or incident in the outside world; and (3) that the feeling shall be enriched by organic sensations, set up in the course of bodily adjustment to the incident. The emotion itself, as experienced, consists of a strong affection, and

a simultaneous association of ideas, some of the part-processes in which are always organic sensations.

In adult life, an emotion is hardly ever found 'pure'; consciousness is too complex, and the habits of connection formed by the part-processes in ideas too numerous. Thus the 'angry consciousness' described in § 4 contains a good deal more than the pure emotion of anger.—The formation of an emotion occupies so short a time that it is impossible to experience separately the two stages depicted in the text. Feeling and bodily adjustment come together; their association is simultaneous. Logically, and in primitive experience, the feeling comes first, and the adjustment afterwards.

The feeling, which makes up the body of the emotion, differs somewhat in composition, according as it is pleasurable or unpleasurable. The having of a pleasant experience means that the physical conditions are favourable to the arousal of a large number of ideas; the having of an unpleasant experience, that they are unfavourable (§ 38). Hence, the feeling contained in a pleasurable emotion is extremely rich in ideas, while that contained in an unpleasurable emotion is comparatively poor. In joy, ideas crowd in upon us; our thoughts fly hither and thither. In sorrow, we brood upon one narrow set of ideas.

The importance of organic sensations as factors in emotion is shown in many current words and phrases which describe the emotive state. We are 'oppressed' by care; we 'cannot bear' certain people; we are 'cast down' by bad fortune; 'mortified' (bruised or pounded) or 'exasperated' (roughened) by a friend's conduct, etc. 'Anger' means a choking or strangling,—a group of organic sensations which we now attribute rather to baffled or impotent anger than to anger itself. 'Fear' is the state of mind (and body) of the way*farer;* etc.—*Cf.* also § 59.

§ 58. **The Forms of Emotion.**—Just as there are two kinds or classes of feeling, so there are two of emotion: the pleasurable and the unpleasurable. Within each kind or class there are a large number of special emotive forms,

as there are a large number of special 'feelings.' Can we name these forms, and so classify emotions, as we classified sensations and ideas? Or must we be content with the general distinction of the two classes, as we were compelled to be in the case of feeling?

(*a*) An emotion arises when a situation or predicament arises. If, then, we could ascertain the typical situations which an organism, placed in the world of nature, must face, — the simplest and most inevitable situations of the physical world, — we could determine the fundamental emotions. And we could then attempt to derive the other emotions from the standard emotions, and thus obtain a complete table of emotive forms. (*b*) All emotions are coloured by the organic sensations set up during the adjustment of the physical organism to the situation. If, then, we could find typical groups of organic sensations — lung, heart, bladder sensations — appearing in the various emotions, we could, again, determine the fundamental emotive forms. Our 'physical' would be supplemented by a truly psychological classification.

Although there is no reason to suppose that the problem is insoluble, it has not yet been solved. Animal psychology and child psychology, the biological method and the method of introspection, have hitherto failed to give us an answer to it. All that can be done at present is to indicate one or two of the ways in which classification has been tried, with more or less of success, but with no final result.

(1) Emotions fall into two great groups as *qualitative* and *temporal*, — the former depending upon the nature, the latter upon the time-relations of the situations. Thus

hope is a temporal emotion, which may become qualitative in the form of satisfaction (hope fulfilled) or disappointment (hope unfulfilled), or, remaining temporal, may pass into fear (hope deferred). Fear is a temporal emotion, which may become qualitative as alarm (fear fulfilled) or relief (fear unfulfilled), or, remaining temporal, may pass into hope (fear delayed). Joy, sorrow, love, hate, etc., are qualitative emotions.

(2) Emotions fall into two great groups, as subjective and objective emotions. The subjective emotions are those in which the central feeling is made up principally of ideas about oneself; the objective emotions those in which the central feeling is made up principally of ideas derived from outside objects or processes. The most general forms of subjective emotion are joy and sorrow; the most general forms of objective emotion, like and dislike. The objective emotions may again be subdivided, according as the object is a person or a thing. The most general forms of objective person-emotions are sympathy and antipathy; the most general forms of objective thing-emotions are attraction and repulsion. Further, many of the subjective and objective emotions occur in a *more* subjective and a *more* objective form. Thus sorrow, a subjective emotion, has a more objective form, care, and a more subjective form, melancholy. Antipathy, an objective emotion, has a more objective form, hatred, and a more subjective form, exasperation.

There is no such thing as an 'emotion of indifference,' since there is no third affective quality, 'indifference.' But just as a feeling or an affectively toned idea may pass, in course of time, into an indifferent idea, — the affection 'wearing off' with custom, — so a situation, which would naturally give rise to an emotion,

may leave us indifferent. This state of indifference is due to the frequent repetition of a situation, to the conquering of natural by acquired tendencies. Every 'dangerous' profession puts its followers in situations which would call up the emotion of fear in persons unaccustomed to them: no one could do off-hand what is constantly done by miners, sailors, steeple-jacks, etc. And a life of perpetual trouble blunts the susceptibilities. We have an instance of this in Tennyson's poem of 'The Grandmother':—

> "You think I am hard and cold;
> But all my children have gone before me, I am so old:
> I cannot weep for Willy, nor can I weep for the rest."

The indifference which lies midway between joy and sorrow is called composure; that which lies between like and dislike, unconcern. Sympathy and antipathy become apathy; attraction and repulsion, insensibility.

§ 59. **The Expression of the Emotions.** — By the 'expression' of an emotion we mean the bodily effects following from the change in the nervous system which is the physical condition of the emotion. The various forms of emotive expression may be classified under four heads.

(1) Since the core of every emotion is a vivid feeling, we shall expect to find in emotion all the bodily manifestations of the simple affection. We find, as a matter of fact, that every emotion brings with it changes in pulse, respiration, volume and muscular strength.

Method. — Suppose that the subject is in position, as described in § 33 (2). After a short time has elapsed, he is informed, say, that he may smoke. The pleasure of the unexpected news shows itself at once in the records of pulse, breathing and volume; and if the dynamometer be squeezed while the cigar is being cut and lighted, it also gives evidence of the affective process. After another brief interval, the cigar is flicked out of the subject's mouth

by the assistant, apparently as a practical joke. The resultant unpleasantness is clearly marked upon the instruments. — The manifestations of the emotions of pleased surprise and resentment are here identical with those of simple pleasantness and unpleasantness.

(2) But the emotion is the conscious way of taking not an impression, but a situation, a number of simultaneous impressions; and the situation is a far more serious matter to the organism than the separate impression. The bodily changes set up directly by the change in the nervous system are therefore more intensive and more far-reaching than those just mentioned: they extend beyond heart, lungs and voluntary muscle to the secretory organs and the other involuntary muscles. Thus in fear the skin is pale, the breathing shallow and hurried, the pulse weak and irregular, and the muscular strength diminished. At the same time, the salivary glands cease to act, so that the mouth and throat become dry; the body is bathed in a cold sweat; the bladder and intestine are affected (tendency to urination and diarrhœa): while there is a 'sinking of the stomach' with consequent nausea, a tremor of the whole body (shivering and goose-flesh), and an erection of hair due to the contraction of the unstriped muscles lying beneath the skin. In the emotion of impotent rage there is a sensation of choking, and, oftentimes, a derangement of the liver. In grief we have an excessive action of the lachrymal glands. These bodily symptoms are less well marked in the case of pleasurable emotions; though we find tears shed in moments of great joy, and a tendency to urination when the body is shaken by violent laughter.

We cannot say anything very certainly of the physiological mechanism of these various manifestations of emotion. It is natural that, when the organism is affected as a whole, the whole sys-

tem of organs in which the vital functions are seated should show signs of the shock. But this 'naturalness' does not account for the particular symptoms of particular emotions.

(3) The organism has to 'face' the situation, by way of a *bodily attitude*. The reasons for the special forms of this attitude must be sought from biology. What concerns us here is the fact that we have in certain emotive expressions an illustration of the psychological law of association. For certain biological reasons, the frightened animal crouches down, the angry animal attacks the object of its anger, the startled animal leaps away from the unexpected impression. In civilised life, some of these actions have become unnecessary, and others are partially inhibited by acquired tendencies. Nevertheless, the association of a definite group of organic sensations to the feeling which reflects a definite situation tends to persist. Although we do not crouch down, as if actually to hide ourselves from a stronger opponent, we do 'shrink into ourselves' when we are expecting censure or bad news; although we do not attack when we are angry, we do clench the fist and brace ourselves as if in preparation to attack; and although we do not leap away, we do 'jump' or start when we are surprised. In the wince and brace and start we have survivals of the primitive bodily adjustment by which the organism faced three typical 'situations'; and our emotion is not complete until the organic sensations aroused by them have been added to the mass of ideas contained in the central feeling.

(4) When we speak, in ordinary conversation, of 'expression,' we mean the expression of the face. The muscles of the face are arranged round three very important sense-organs, the organs of vision, smell and taste,

and their adjustment forms a part of the total bodily adjustment to all the many situations which appeal to those senses. But that is not all. It is a remarkable fact that the facial muscles contribute something to the expression of emotions in which they are not directly concerned. Thus the injured man 'looks bitter'; *i.e.*, looks as he would look were an unpleasantly bitter morsel placed upon his tongue. The disappointed man 'looks sour'; *i.e.*, looks as he would if he had taken a sharply acid substance into his mouth. In surprise, the eyebrows are raised, as if to afford a free *view* of the surprising object; and so on.

In attempting to explain this transference of expression, — the association of what were originally reflex movements, made in response to definite sense stimuli, bitter, sour, etc., to an emotion which does not include the sensations set up by those stimuli, — we must remember two things: that gesture was far more essential for the communication of ideas among primitive men than it is now, and that the primitive vocabulary was limited. To convince ourselves of the latter fact we have only to look at the derivation of abstract words: we find constantly that they contain a metaphor, *i.e.*, that they originally designated something concrete. Thus *black* is 'that which is scorched'; an *animal* is 'that which breathes'; to *explain* is to 'spread out' or 'level.' This means that complex states of mind, such as emotion, would be spoken of, at first, in a metaphorical or partial way, and that the spoken word would be eked out by gesture. The metaphors employed would be taken from the familiar incidents of everyday life. The primitive hunter 'tasted' success, in a very real way. The unsuccessful 'tasted' life also, and found it bitter or sour. The mouth of a maiden is 'sweet'; 'honey and

milk are under her tongue.' The unpopular man 'stinks in the nostrils' of his tribesmen. We cannot 'see' the point of a remark, or the reason for an action.

Whenever one of these metaphors came to mind, and still more certainly, whenever one of them came to the lips, the reflex expressive movements of the facial muscles would be set up. Certain part-processes in the central feeling suggest the metaphor; the metaphor brings the bitter or sweet or surprised 'look' with it; and the 'look' persists as a constituent in the total emotive expression, because of its original utility for the communication of ideas, and the consequent stability of its connection with the feeling.

Laughter. — Laughter consists of a certain play of feature, and of a series of long inspirations, each of which is followed by a number of abrupt expirations. It occurs under the most various conditions. We speak of it as sardonic, contemptuous, derisive, sympathetic, hysterical, joyous, etc.; it expresses the sentiment of power; and it follows tickling and certain acute pains. No explanation which has as yet been offered is entirely satisfactory.

(1) Some authorities regard the laughter which follows tickling as typical laughter. Tickling consists of intermittent light pressures. Each pressure, it is said, sets up a reflex constriction of the small arterial blood-vessels of the body. When the arteries are constricted, the amount of blood pumped through them by the action of the heart is, of course, diminished. There is a close connection between the nerves governing the blood-vessels and the nervous centre which regulates breathing. Hence the intermittent arterial constriction is paralleled by an intermittent expiration. This latter serves a useful purpose, since it prevents the outflow of blood from the brain. The brain arteries are constricted, along with the rest; less blood gets to the brain; the movements of laughter prevent this blood from escaping too quickly.

(2) Other psychologists look upon laughter as intrinsically an expression of joy. When we are pleased, all the bodily activities are heightened, and a safety-valve is required. We 'let off steam' by laughing. The muscles of face and respiration are employed to let off the surplus energy of the body because they are constantly in use; the energy runs off most easily by way of them.

On either of these explanations, laughter would fall under our second principle. It would be the direct result of a change in the nervous system. The suggestion has been made, however, that the play of feature in laughter, the opening of the mouth and nostrils, may be the (3) expression of a desire to 'take in' the whole of the pleasant experience. We 'take in' a comic situation, just as we take in a pleasant morsel of food or a pleasant odour. On this side, then, laughter would fall under our fourth principle.

Summarising this Section, we may say that the expressions of emotion include (1) the manifestations of simple affection; (2) an extension of these manifestations to the secretory organs and the whole system of involuntary muscles; (3) relics of actions, once performed in obedience to biological necessities; and (4) reflex movements which were primarily executed in response to certain sensory stimuli, and have now become associated to emotions along with the sensations set up by those stimuli. The second of these expressions shows the serious nature of the situation to be faced; the last two make up the bodily adjustment spoken of in § 57.

Those who believe that feelings are simple mental processes, and that they present a large number of qualitative differences (§ 56), would explain the fourth factor in emotive expression a little differently. The emotion of care, they would say, is *like* the 'feeling of oppression'; the emotion of disappointment is *like* the 'sour feeling' due to an acid taste. And there is a law of the association of feelings: Like feelings tend to associate.

We have found good reason to believe, however, that the feeling

is a compound process, and that there are but two affective qualities, neither of which can stand alone in consciousness. We have further found that the compound processes which we call 'ideas' do not associate as wholes: association 'by similarity' is a form, not a law, of association. We shall not expect to have any such law of association, then, in the sphere of feeling.

As a matter of fact, we do not find affection serving as the associative link between two complex processes. There is no reason why a *particular* pleasant experience should call up another *particular* pleasant experience: the pleasantness is too general, too evanescent, and too much dependent upon its sensory concomitants. The pleasant warmth of my room does not call up the pleasant breakfast that I ate an hour ago. If it calls up anything, it does so because it is pleasant *warmth;* thus it may call up the pleasant lunch that I ate at a German inn after a cold tramp, because one of the factors in the lunch-memory is the *warmth* of the inn-parlour. The associative link must be looked for always on the sensation side of the feeling; and the association must fall under the formula *ab–bc*.

Although the description and observation of emotive expressions do not require the use of introspection, *i.e.*, do not constitute a psychological problem, the facts themselves are too useful to the psychologist to be neglected. It is not only that (1) the composition of the emotion, as stated in the text, furnishes illustrations of the association of ideas. The observation of the various forms of expression is of psychological value (2) in that it helps us to analyse and reconstruct a particular emotion; we know what sort of organic sensations to look for and take account of. In certain cases, these sensations determine the affective quality of the whole emotion; their intensity may, *e.g.*, render an extreme joy unpleasant. And it is of further value (3) in that it enables us to understand how the *idea* of pleasantness or unpleasantness, which is implied in every case of affective introspection (§ 33), takes shape. The idea of affection may be a mass of organic sensations, which have 'expressed' a certain emotion; or the visual picture of oneself under the influence of emotion; or a word which con-

tains a metaphor borrowed from sense (my idea of the unpleasantness of a colour may be that it was a 'hard' or 'cold' colour, etc.); or, finally, the word 'pleasantness' or 'unpleasantness' itself, — the word having been in the first place attached to some one of the foregoing ideas, as an associative supplement, but now detached from its associations (*cf.* the verbal local sign: § 44). Moreover, it is a conjecture by no means improbable that (4) emotive expression furnished the first psychological problem; that the science of mind began with its examination. Expressive movement is evidently well fitted to serve as a bridge between the sciences of nature and the science of internal experience (*cf.* § 2).

§ 60. **Mood, Passion and Temperament.** — An emotion, regarded as a single total process, has three attributes: quality (pleasantness or unpleasantness), intensity and duration.

Nothing very definite can be said either of the intensity or of the duration of emotion. It may be laid down, as a general rule, that the most intensive emotions have the shortest duration, and the weakest emotions the longest. The rule follows naturally from the nature of emotions. A severe shock to the nervous system, such as is implied in an intense affection, must exhaust the organism more quickly than a slight shock: the violent emotion, if pleasurable, soon gives way to a general lassitude and indifference; if unpleasurable, is ended by a swoon or faint.

The weaker emotive states, which persist for some time together, are termed *moods*; the stronger, which exhaust the organism in a comparatively short time, are called *passions*. Thus the mood of cheerfulness represents the emotion of joy; the mood of depression that of sorrow. Like and dislike have the moods of content and discontent; sympathy and antipathy, those of kindliness and sulkiness; attraction and repulsion, those of 'charm' and

tedium. The mood of care is anxiety; the mood of melancholy, gloom. The mood of hatred is 'not getting on with' a person; the mood of exasperation is chagrin. On the other hand, rage or fury is a passion, anger an emotion; and we speak of a 'passionate grief,' a 'passionate love,' a 'passion of terror,' etc., when we wish to indicate a high degree of emotive intensity.

Regarded from the affective standpoint, mood evidently bears the same relation to emotion that the affectively toned idea bears to the feeling. The word 'passion' is used, loosely, to express a very intense feeling, as well as a very intense emotion. We say that a man 'has a passion' for collecting butterflies, meaning that the butterfly-idea calls up in him a very strong feeling.

Language rarely, if ever, distinguishes more than two degrees of emotion proper, between the slight affective intensity of the mood and the strong affection of the passion. Thus we have the series: irritability (mood), aversion (weak emotion), anger (strong emotion), rage (passion); or chagrin (mood), mortification (weak emotion), resentment (strong emotion), exasperation (passion); or kindliness (mood), friendliness (weak emotion), 'affection,' in the sense of 'liking' (strong emotion), love (passion); or wonder (mood), surprise (weak emotion), astonishment (strong emotion), amazement (passion).

No sharp line of distinction, either intensive or temporal, can be drawn between these various processes. We cannot say that a mood lasts for a week, and an emotion for a day; or that a passion exhausts us in five minutes, and an emotion in five hours.

One of the difficulties in the way of a *classification* of the emotions has been brought out, in all probability, by the instances just cited. The reader has probably said to himself: 'I should

not put *that* emotion *there!*' This difficulty is inherent in the nature of language, which, as we have seen (§ 33), has been developed as a medium for the communication of ideas, not of feelings or emotions. The words which denote emotions are neither sufficiently numerous nor sufficiently delicate for psychological purposes; they are rough, general names, carrying different side-meanings to different minds.

Hence it is not likely that any two psychologists would make up series, of the kind just given, in precisely the same terms. The emotions of each series differ in more than the single aspect of intensity. When we ask ourselves whether anger, *e.g.*, is really nothing more than a stronger aversion, or love nothing more than a stronger affection, we are obliged to confess that there are other differences. The central feelings differ not only in degree of affection, but in composition, in the number and nature of their component sensations.

It is noteworthy that language has but few words to express pleasurable emotions. We can be annoyed, vexed, irritated, disturbed, ruffled, chagrined, bothered, aggrieved, huffed, nettled, piqued, put out, on the unpleasant side; on the pleasant, we have little more than the general terms satisfaction and contentment, the pleasure of 'things running smoothly.' This accords with the fact that the direct bodily manifestations of unpleasant emotions are more extensive and more varied than those of the pleasurable states (§ 59). It places a further difficulty in the way of classification.

The mood stands upon the same level of mental development as the train of ideas. Just as the train of ideas is determined by intellectual constitution, following always the line of least associative resistance, so is mood determined by affective constitution, or, as it is more usually called, *temperament*. It is customary to distinguish four temperaments: the choleric, sanguine, phlegmatic and melancholic. The man who thinks quickly and feels strongly is choleric; the man who thinks quickly and

feels weakly, sanguine. The phlegmatic thinks slowly and feels weakly; the melancholic thinks slowly and feels deeply.

These affective temperaments stand upon the same level as the three 'intellectual temperaments' of § 54: the co-ordinating, subordinating and superordinating dispositions.

In real life, we rarely come across 'pure' temperaments; human nature is too complex to be run into a single mould. Literature, however, furnishes us with typical instances of the four temperaments. Thus Hamlet and Laertes are respectively melancholic and choleric; Falstaff and the younger Percy, in the first part of *King Henry IV.*, respectively sanguine and choleric; while the scenes between Touchstone and Audrey in *As You Like It* bring the sanguine and phlegmatic temperaments into sharp contrast.

References for Further Reading

James, *Principles*, II, xxiii, xxv.
Külpe, *Outlines*, §§ 52, 54.
Wundt, *Grundzüge*, II, xviii, xxii (§ 1).
Consult also: A. Bain, *The Emotions and the Will*, 3d edn., 1880; C. Darwin, *The Expression of the Emotions in Man and Animals*, 2d edn., 1890; A. Fouillée, *Tempérament et caractère*, 1895; F. Galton, in *Psychol. Rev*, 1894; C. Lange, *Ueber Gemüthsbewegungen*, 1887; A. Mosso, *Fear*, 1896; Th. Ribot, *Psychology of the Emotions*, 1897; W. Wundt, in *Phil. Studien*, 1890.

CHAPTER X

Voluntary Movement. The Analysis of Action

§ 61. **The Nature of Action.** — Every animal organism is a *motor* organism. The animal is constantly moving, either moving from place to place or changing its attitude, *i.e.*, the relative positions of limbs and trunk. We have already had indications of the importance of movement in psychology (Chs. VI, VII, IX); and we must now supplement what we have said of it in previous chapters, in order to set this importance in a clearer light.

Animal movements are of two kinds: voluntary and involuntary. Psychology has to take account of both, though in different ways. Voluntary movement presents two points of interest to psychology: it has conscious antecedents, — conscious conditions, — and it gives rise to conscious processes during its performance. Involuntary movement, on the other hand, has no conscious antecedents; we have to consider it only in so far as its performance involves the arousal of conscious processes, organic sensations.

The name of *involuntary movements* is given to the purely mechanical movements of heart, lungs, vessels, intestines, etc. These movements go on whether we are conscious or not; they continue in the deepest sleep, in the hypnotic trance, and in the most profound swoon, as steadily as in the waking life. Their conditions are

entirely physiological; we have the power to vary some of them (we can breathe quickly, *e.g.*), but we cannot arrest them, and start them again, at pleasure. As a rule, they pass wholly unnoticed. But if they reach a certain degree of intensity, they give rise to organic sensations, cardiac, respiratory, circulatory, etc., sensations, and the sensation of pain. It is only under these circumstances, as the stimuli to organic sensations, that involuntary movements fall within the range of psychological survey. We need devote no space to them in the present chapter, as we have discussed their effects in dealing with emotive expression (§ 59).

All the other movements of the organism are comprised under the term *voluntary movements*. These do not occur except under definite psychological conditions, the chief of which is attention. As they occur, they give rise, like the involuntary movements, to organic sensations, which in some instances pass unheeded, but in others are remarked, and turned to account by the organism for the acquiring of knowledge of the outside world. Our psychological analysis, therefore, must take account of both these sets of processes: the mental con ditions and the mental concomitants of voluntary movement.

It must be clearly understood that there is no conscious process corresponding to the *release* of a voluntary movement, to mov*ing*. We have first a complex of processes in consciousness, and a certain state of things in the brain cortex; then we move; then we have certain organic sensations in consciousness, and another state of the brain cortex. The middle term of the series, the moving, does not come into consciousness.

The point will be made clearer if we draw a parallel, in general

terms, between the physiology and the psychology of voluntary movement. On the physiological side, an impression is made upon a sense-organ: a nervous excitation travels to the corresponding sensory area of the cortex, and (1) explodes a sensory cell there. The explosion is reinforced by energy from the association centres, and in virtue of this reinforcement has an effect upon the whole nervous system. More than this: the explosion is communicated to a motor cell, and so sets up an excitation in a motor nerve; a motor excitation travels outward to a muscle, and (2) a muscular contraction, a moving, results. The contraction of the muscle stimulates the sensory nerve-endings contained within its substance and within the tendons attached to it, as well as those upon certain articular surfaces; another sensory excitation travels to the brain, and (3) the explosion of other sensory cells, in a different cortical area, follows. On the psychological side we have (1) a sensation (explosion of sensory cell), which is attended to (reinforcement from the association centres) and felt to be pleasant or unpleasant (effect upon the whole nervous system), and (2) organic sensations, due to muscular contraction. There is, however, no conscious process corresponding to the motor excitation, no sensation set up by the explosion of the motor cell. It is not until the second group of sensory cells is exploded that we have a second conscious process.

Method. — The following experiment shows that there is no such thing as a motor-cell sensation, a sensation corresponding to the innervation of a muscle or group of muscles. Cut a circular piece of hard wood, one inch in thickness, to the weight of 50 gr. Cut another disc, of one-third the diameter of the first, from the same wood; hollow it, and prepare a cap of wood to fit the top of the hole. Put enough shot in the hollow to bring the total weight up to 50 gr., packing the shot with cotton-wool, so that it does not rattle. The two weights now appear to be both alike of wood. Let the subject lay his arm upon a low table, palm upwards. Place first the large and then the small weight in his palm, and let him lift them, moving his arm from the elbow. If he has not been informed that the pieces are of the same weight, he will say that the smaller is markedly heavier than the larger.

This judgment, however, might be made, even supposing that there were an innervation sense. The subject thought that the two weights were of the same material, and therefore expected that the larger would be the heavier. In his surprise at the heaviness of the smaller piece, he thinks that it is heavier than the other, although the two are really of the same weight.

Now repeat the experiment, after telling him that the two are equal, and showing him that the balance makes each of them weigh 50 gr. *He will still find the smaller piece the heavier.* If he were judging by the help of a motor sensation, this illusion would now be impossible; for, knowing that the same amount of energy would be required to lift both weights, he would innervate his muscles to the same extent, *i.e.*, have precisely the same innervation sensation. The illusion must be due to ingoing, not to outcoming, sensations, and is, in fact, to be explained principally by the circumstance that the larger piece stimulates a large number of cutaneous sensory nerve-endings slightly, while the smaller stimulates a few intensively.[1]

The problem which voluntary movement sets to psychology is the analysis of *action*. The word 'action' denotes both the mental condition and the mental concomitants of movement. It is usually qualified by an adjective, which indicates the nature of the condition. Thus the phrase 'impulsive action' covers both the impulse and the impulsive movement, with the sensations which it occasions, — both the mental condition and the mental concomitants of a certain change of bodily position; the phrase 'selective action' covers both the process of choice and the sensations set up by the movement which follows it; the phrase

[1] The question whether there is a sensation accompanying the touch-off of a movement must not be confused with the question whether a conscious process accompanies the touch-off of a tendency (§ 36). The former asks: Does the explosion of a motor cell give rise to sensation, as the explosion of a sensory cell does? The latter: Is there any conscious process attending the rush of an idea into the channel which tendency has dug for it?

'instinctive action' covers both the instinct, — the mental condition, — and the sensations aroused by the instinctive movement.

'Movement' is, therefore, a more general word than 'action.' All actions are, in part, movements; but only those movements which have conscious processes as their conditions, and other conscious processes as their concomitants, can form part of actions. In ordinary conversation we extend the meaning of the term 'action' until it is almost identical with that of movement: we say, *e.g.*, that a machine 'acts' in this way or that. But we have already had occasion to notice the fact that the scientific meaning of words may differ considerably from their popular meaning (§ 2).

§ 62. **The Beginnings of Voluntary Action.** — There is no type of voluntary action, occurring in concrete experience, which can be regarded as the simplest form of voluntary action in general, the form out of which all the more complex types have grown. This is not to be wondered at; for we could no more expect to find such a rudimentary action within the circle of processes composing the adult consciousness than we could to find bare sensations not yet combined into ideas. All the sensations which we experience are elements in ideas, *i.e.*, sensations which bring with them habits of connection with other sensations, and all the actions which we experience are actions whose conscious conditions include the memory of past actions. Now it is plain that the earliest sense-process could not have had a habit of connection, since there was nothing for it to connect with. Hence we are justified in assuming the existence of the bare sensation, and in inferring its attributes from the attributes of the sensations which we know. And it is plain that there

must have been action, before the memory of past movements had been acquired. Hence we are justified in assuming the existence of an original type of action, — a type which represents an earlier stage of organic development than any which is now represented in our own consciousness, — and in inferring its nature from the nature of the actions which are known to us.

So far as we can tell, the single condition of voluntary action in the primitive consciousness was *attention*.[1] Some object or process in the outside world caught the attention of the organism. This attention meant movement of the whole organism to or from the object: towards it, if its idea was pleasurable, away from it, if its idea was unpleasurable. The movement must be supposed to have taken place whether the object was attainable or not.

Action of this rudimentary kind may be termed *action upon presentation*. A stimulus was presented; it attracted the attention; movement followed. The animal had never formed any idea of its own movement, because it had never moved voluntarily before; it did not know what sort of mental processes would be set up by movement; it did not know that it was going to move. But so soon as the excitation corresponding to the idea of the stimulus had been reinforced by other excitatory processes, — so soon as the stimulus was attended to, — motor excitation was set up, and a movement made. — In action upon

[1] One might be inclined to think that there would be another condition, — the pleasantness or unpleasantness of the object. But for the primitive organism, attention to anything but the intrinsically pleasant or unpleasant is impossible: attention and affection are always obverse and reverse of the same process (§ 38).

presentation we have the germ of all the types of action found in concrete experience.

We can never be sure that any animal movement, however rudimentary the organism, is a pure action upon presentation. It is possible that we have an instance of such action in the movements of the simplest unicellular organisms, *e.g.*, the amœba, toward a fragment of food-stuff or away from a drop of acid. The object, if edible, gives rise to a vague idea, vaguely pleasurable. The rudimentary attention involved is the psychological condition of a movement of the total organism: the amœba flows towards the fragment, pours itself out, so to speak, in this or that direction. If the object is deleterious, there is a reverse movement, a shrinking back of the whole mass of protoplasm.

§ 63. **The Nature of Impulsive Action.** — We have assumed that action began as action upon presentation. Whenever we look introspectively at an action of our own, however, — whenever we try to analyse a concrete action-consciousness, — we find no trace of anything except *action upon representation*. The actions which we ourselves perform involve the idea of past movement, a conscious re-presentation of some movement previously performed. The simplest form of action upon representation is *impulsive action*. A large proportion of the actions of animals which stand low in the scale of development are, so far as we can interpret them, impulsive actions. And there can be no doubt that actions of this type form a part of the sum of movements executed by the higher animals and by man.

Suppose that I am hungry, and see a supply of food. The idea of the food possesses me, holds my attention. At the same time that I have this idea, I have the further ideas of a movement towards the food and of its seizure.

That is to say, the sight of the food brings up in my mind memories of all the organic and other sensations which would be aroused by a real movement towards the food. The attention is now directed, not upon the idea of the food, but upon the idea of the food *plus* the idea of my own movement. Attention to this pleasurably toned compound idea is the psychological condition of actual movement: my hand goes out towards the plate, and the sensations which I had imagined are realised. I have the experience of a simple impulsive action.

There is a great difference between this action and action upon presentation. I do not merely attend to the food, and take it; I attend to the food *and* to an idea of my movement towards it, — and then take it. The impulsive action presupposes the representation in consciousness of a movement formerly made.

But although in psychological analysis the difference between the two actions is so great, for all practical purposes it may be very small. Granted that I have an idea of previous bodily movement, I am not necessarily much better off than I was before. The movement which I remember may be exceedingly roundabout, or may be far more violent and exhausting than the present occasion demands. The mere idea of *a* movement is not enough: what I need is the idea of the *right* movement, *i.e.*, of the movement which will take me most quickly and by the most direct road to the food which I see. It is only when the *right* movement comes to mind at sight of the food that the impulse has reached its full development. How does this development proceed?

The idea of movement which comes up when I see the food arises by way of simultaneous association. Food-

idea and the sensations aroused by forward bodily movement have been associated in past experience: therefore when the food-idea appears, the sensations aroused by movement tend to appear with it. The question how the impulsive action developes, then, resolves itself into the question: How is it that the idea of the *right* movement comes to be associated, more firmly than all other possible ideas of movement, to the food-idea?

The answer is, in brief, that the performance of the right movement makes the whole experience more pleasant than the performance of any other movement could do. We have seen that the pleasantness of an event, *i.e.*, its hold over the attention, gives its idea a power of connection, a grip upon other ideas, which it would not have in its own right (§ 55). Hence the movement which brings pleasure in the greatest degree will be more firmly cemented to the food-idea than will another movement, which brings pleasure in a less degree.

How is the pleasantness produced? Why is it that the right movement brings more pleasure than any other could? In the first place, the idea of the food is pleasant; attention to it means a forward, not backward, movement. In the second place, this movement is a means to an end, not itself an end. Hence the most pleasant idea of movement will be the idea of a quick and straight movement, a movement which does not involve delay or too great effort. And in the third place, the idea of the result of the movement, the idea of an immediate satisfaction of my hunger, is pleasant; and the satisfaction comes most quickly with the quickest and most direct movement. This idea of the *result* of the impulsive movement is a factor in the total experience which we

have not mentioned before: it is an idea which must evidently come up in consciousness after action upon presentation has made us familiar with the consequences of movement, and an idea whose pleasantness will have a great deal to do with the shaping of the impulsive action. The more vivid the idea of result, the more accurate becomes the representation of the movement. When the impulse has reached its full development, it is sometimes difficult to say, from introspection, whether the ultimate psychological condition of the action is attention to the object (food), or attention to the result of the movement (satiety). It seems that the idea of result tends more and more to replace the idea of the object, as consciousness advances in complexity.

If we put together the results of the last two Sections, we obtain the following scheme of development: —

(1) *Action upon Presentation.* — Food is presented; it is attended to, and found pleasurable; movement towards follows. Or an injurious substance is presented; it is attended to, and found unpleasant; movement away follows.

(2) *Action upon Representation.* — (*a*) The undeveloped impulsive action. — Food is presented (pleasant); remembrance of forward movement supplements it; movement towards follows. (*b*) The developed impulsive action. — Food is presented (pleasant); the idea of satiety supplements it (pleasant); remembrance of direct forward movement (pleasant) supplements these ideas; direct movement towards follows. Or an injurious object is presented (unpleasant); the idea of personal safety supplements it (pleasant); remembrance of direct movement away supplements these ideas; direct movement away follows. Whether the total action-consciousness in this case is pleasant or unpleasant depends upon circumstances. Movement away is unpleasant; direct movement away, however, is less unpleasant than any other form of retreat. There

is an algebraic summation of pleasantness and unpleasantness, and the resultant affective quality depends upon the relative preponderance of the ideas of injury and safety.

We can trace the development of impulsive action in the movements of young children. It has been suggested that the more or less random actions of the newly born infant may be actions upon presentation, actions of the whole organism set up directly, in response to a pleasurable or unpleasurable impression, without any 'idea of movement,' any revival of the organic sensations aroused by previous movement. The question is complicated by the fact that, at this period of life, the cortex is not fully developed. If there be a sub-cortical consciousness (replaced later by the cortical), then we must reply to the suggestion that the infant moves in the fœtal state, and thus makes acquaintance with its organic sensations before birth. In any event, observation of the 'random' actions made in the first few days of infancy shows that they can all be classified as incomplete or rudimentary impulsive or reflex (§ 66) movements; we have only to wait a little, until the cortex matures, to see them pass into the fully developed form. Even the movements of the amœba, referred to in the foregoing Section, may perhaps be impulsive. The movements towards and away may be differently 'sensed'; the food-idea may be supplemented by one 'organic sensation,' and the idea of the deleterious substance by another.

Method. — You may convince yourself of the great difference between action upon presentation and action upon representation, *i.e.*, of the extreme importance of the idea of movement for the regulation and perfecting of action, by the following experiment. Fix the attention steadily and intently upon some idea of bodily movement; say, the rising to open a window. You will find that, as you attend, the impulse to rise grows stronger and stronger, until finally you can overcome it only by an effort, — by the idea that you do not really want the window open, that you are merely making an experiment, etc. If the movement-idea is so powerful in the adult consciousness, with all its complicated mechanism for inhibition, we may imagine

what it must be in the mind of the animal or child or savage, where the inhibitory mechanism is very much less developed.

§ 64. **The Place of Impulse in Consciousness.** — We mean by 'impulse' the complex of processes which forms the psychological condition of the impulsive movement. This complex is a simultaneous association of the idea of the object, the idea of movement to or from the object, and the idea of the result of the movement, — the whole complex being the object of passive attention. Impulse, as thus understood, is closely related to the two complex processes which we have termed feeling and emotion. The three experiences may be distinguished as follows.

The impulse differs from the feeling in three respects. The feeling contains a single idea or perception; the impulse contains three. Moreover, in the feeling the affection is stronger than any sensation in the complex; in the impulse, the ideas have a very considerable part to play alongside of the affection. There is, further, a difference in the physiological conditions of affective expression and impulsive action, which leads to a difference in psychological experience. The 'expression' of the feeling is diffused over the whole body; so far as it is muscular, it consists simply in a general strengthening or weakening of the whole muscular system. The expression of the impulse is a definite movement, a definite group of muscular flexions and extensions; and the organic sensations arising from this movement are remembered, and turned to account for the shaping of future impulsive movements, *i.e.*, included in future impulses.

The impulse differs from the emotion in two respects. Organic sensations enter into the central feeling, the

'body' of the primitive emotion *after* that feeling has taken shape; they are present in the primitive impulse from the very first. Hence although the attention implied in the formation of the emotion and the impulse is the same, — passive attention, — there is noticeably more effort in the impulsive than there is in the emotive consciousness. And secondly, the organic sensations aroused by emotive movements are far more complex than those which attach to the ideas of object and result in impulse. In the emotion, they proceed from a large number of bodily organs, and from the whole muscular system; in the impulse, from one group of muscles.

It must be noted that the first of the two differences between impulse and emotion can be brought to light only by an appeal to the *primitive* forms of the two processes. In adult experience, we have no knowledge of two stages of formation in the emotion (§ 57). But the effort-factor present in impulse is a reminder that those two stages did once exist, and that they have no counterpart in impulse itself.

§ 65. **The Forms of Impulse.** — Impulses fall into two great classes: impulses towards, and impulses away from.

Just as we should be able to obtain a satisfactory classification of the emotions if we could determine the inevitable and typical 'situations' which an organism must face, so we should be able to classify impulses, if we could determine what ideas of objects inevitably attracted the attention, were uniformly supplemented by the idea of movement, and so gave rise to typical impulsive actions. But the conscious processes given in actual experience are so intertwined and tangled that no one has hitherto succeeded in making out a list of such ideas.

It is customary to classify impulses by the *results* of impulsive action, *i.e.*, to make a list not of the objects which evoke that action, but of the end or aim of the movement, as it is seen by the outside observer. We saw that emotions might be classified, upon a similar principle, as subjective and objective emotions, the former consisting principally of ideas about the subject experiencing the emotion, the latter of ideas of the situation which aroused it. Regarded from this point of view, impulses fall into two groups: subjective or individual, and objective or social impulses. The result of impulsive action in the first case is to accomplish something for oneself; its result in the second case is to accomplish something for others as well as for oneself.

The most general forms of subjective impulse are the impulses of nutrition (impulse towards) and defence (impulse away from). The objective impulses appear at three levels of mental development, as the sexual impulses (attraction and repulsion), the parental impulses (affection and exclusion) and the tribal impulses (friendliness and hostility).

Instances of movement following from these impulses would be the reaching after food in hunger; the clenching of the fist in anger; choosing a mate within a single race or species; the care devoted to one's own offspring and the 'stepmotherly' treatment of members of other families; actions due to professional or class bias, to imitation of one's neighbours, etc. All forms of impulse are more clearly shown in the animals than in man.

The close connection between impulse and emotion is brought out by the fact that some of the words used in the text to designate impulses (attraction, affection) have already been used to designate emotions (§§ 58, 60). The words, of course, have different meanings, according as they denote an impulse or an

emotion (§ 64); but the necessity of employing one word in two senses adds to the difficulty of classification under both heads. — The clenching of the fist in anger is an expression of impulse, which has become incorporated in an emotive expression. Originally, the movement was the expression of the impulse to strike, and in some cases it still retains this character. It is then a complete and final expression, and the sensations set up by it are attended to until it is carried out promptly and effectively. As part of the expression of an emotion it is a relic of impulsive action, and the sensations set up by it serve merely to colour the central feeling.

§ 66. **Reflex Action.** — (1) When the impulsive action has reached its highest development, the idea of movement which supplements the idea of the object is an exact image, a memory photograph, of the movement actually performed. (2) But when this point has been attained, there is no longer any need of an idea of movement at all. The idea has been useful to the organism as shaping, guiding, narrowing down the movement actually made; but now that the movement has been guided into precisely the right channels, it may be left to itself. Hence we find that if a particular impulsive action is constantly recurring, the idea of movement, originally contained in the impulse, gradually drops out of consciousness. Some one says to us: 'There's a spider on the back of your head!' — and we raise our hand to brush the spider away, *i.e.*, perform a localising movement, without any thought of the movement itself.

In this case we have the idea of the object (spider) and the idea of result (brushing the spider away). We have no idea of movement, and we do not pay any attention to the organic sensations aroused by the actual movement.

In another instance, we may have but very vague ideas of object and result, and none of the movement. I may be talking interestedly with a friend, and, without any interruption of the train of ideas, put my hand to the back of my head. Finding a spider there, I may say: 'Ah! I thought I felt something!' Here I had some vague idea of object and result, but no idea of either that was at all definite.

(3) The process may be continued still further, until all three of the impulse-ideas, those of movement, object and result, as well as the sensations aroused by actual movement, lapse from consciousness. I may make a localising movement, and flick an insect away, without knowing that I am going to move, that I have moved, that the insect had settled on me, or that I have removed it. I wink my eyes a hundred times a day, without knowing that I do so. I turn my eyes directly upon anything that catches my attention in the visual field, and so bring the particular object upon the spot of clearest vision, without realising that I am moving my eyes or why I am moving them. And so on.

The first of these three types of action is impulsive action which is just poised, so to speak, at its highest level, and which will very soon begin to lose its conscious character. The second action is action which stands half-way between impulsive and reflex action. It is sometimes distinguished, under a special name, as *sensorimotor* or *ideomotor* action. The third is *reflex action:* action which, originally impulsive, has grown so habitual that its pleasure has worn off, and its component ideas and sensations have entirely disappeared from consciousness.

Reflex action, then, is impulsive action which has become a matter of course, and therefore indifferent. It stands to the impulsive action as the indifferent idea stands to the affectively toned idea, or as the states of apathy, composure, etc., stand to emotion. Its conditions are entirely physiological (§ 44). It has no place in psychology in its own right: it calls for mention simply as an instance of the psychological law of habituation. It cannot, strictly, be termed 'action': it is a movement which has taken shape from action. — Whether the automatic, self-regulating movements of heart, lungs, etc. (the 'involuntary movements' of p. 245) have always been unconscious, or are simply very reflex reflexes, degenerate descendants of originally impulsive partial movements of the organism (p. 167), is a debated question. Probability seems to be on the side of their ultimate impulsive origin.

The physiological conditions of reflex action are simpler than those given for voluntary movement in general (§ 61). The reinforcing excitations from the association centres, and the consequent effect upon the whole nervous system, have dropped out of the series. We have only a sensory excitation, sensory cell explosion, motor cell explosion, and motor excitation with its consequence of muscular contraction. Moreover, the sensory cell need not be a cortical cell; it may be a cell in some one of the lower nervous centres (*cf.* § 32).

An impulsive action may pass over into a reflex during the lifetime of an individual. But we inherit the mechanism of most of our reflex actions; the nervous system brings with it a number of ready-made 'reflex-arcs,' *i.e.*, connections of sensory and motor paths. Some of these arcs (sub-cortical) are perfect at birth; in other cases, a little time is required for the sensory-motor connection to become quite definite. The impulses out of which these reflexes have proceeded belong to an earlier period in the life-history of the race or species.

§ 67. **Instinctive Action.** — The true reflex has neither conscious conditions nor conscious concomitants. There is, now, another form of movement, which is derived, like

the reflex, from impulsive action, and which shows many of the characteristics of the reflex, — but which has well-marked conscious concomitants. This is *instinctive* movement.

The conscious condition of impulsive movement is attention to the three ideas of object, movement and result. All these ideas have lapsed from consciousness before movement becomes instinctive, as they have before it becomes reflex. The instinctive movement itself resembles the reflex in the certainty and promptness of its performance, and in its serviceableness to the organism. It differs from the reflex only in its greater complexity: it is more like a series of reflexes. But — and this is the important point — the organic sensations aroused by reflex movement are entirely neglected; the organic sensations aroused by the instinctive movement are attended to, and are highly pleasurable.

Here, then, is the difficulty of the problem which instinctive movement presents to the psychologist: How are we to reconcile the fact that the movement has become mechanical and reflex-like, by frequent repetition, with the other fact that the affection has not worn off the sensations which accompany it?

First let us be sure of the facts. We shall get our best illustrations of instinctive movements from animal psychology. (1) There is no idea of the *result* of instinctive movement. — To prove this we may take the instance of the second year's bird which builds the nest peculiar to its species, or of the caterpillar which spins the complicated cocoon of its species. The animals have no pattern to go by: there can be no idea of the completed nest or of the finished cocoon. (2) There is no idea of the *object* to or from which movement is to be made. — The newly hatched chick pecks

at a newspaper under its feet, and ducks its head and runs when a pigeon's wing flickers over the barn-yard. We say: 'It takes the printed letters for grains' and 'It thought it saw a hawk.' But it never has seen either grains or hawks. Evidently, then, it can have no idea of the object to or from which it is moving. The movement is touched off, reflexly, by the sensory stimulus, just as is the really reflex movement of the hand, whereby an insect is flicked away from the coat upon which it has settled. (3) There is no idea of the *movement* to be made.—The cage-reared migrant beats its wings against its cage at the approach of winter, in its endeavour to fly south. It never has flown south: it can have no mental representation of organic sensations which have never been presented in its consciousness. (4) The sensations aroused by instinctive movements are pleasant.—This is borne out by introspection, and follows from such instances as that just given, where the pleasantness of the organic sensations aroused by instinctive movement is strong enough to overcome the unpleasantness of bruised breast and wings. We see the same thing in the fighting instinct developed among many animals during the period of courtship. The consequences of the combat are often unpleasant; but the instinctive movements still continue, their pleasantness overcoming the unpleasantness.

To reconcile the two facts we must have recourse to biology. There are some things which the organism cannot afford to neglect, which it must attend to, if it is to survive (*cf.* § 38). The bodily changes set up by instinctive movement *must* not be neglected. The movement is of the greatest importance to the organism; and it is too complicated to become altogether unconscious, to be turned over entirely to the lower nervous centres for regulation.

To this statement we may add the considerations brought forward with regard to the organic sensations in § 56. If we go back to the sources of the reflex and instinctive actions, we see that the organic sensations which enter into the instinctive con-

sciousness would be more intensive than those aroused by the reflex. It is natural, then, that their affective tone should not wear off. Organic sensations remain pleasant or unpleasant, if they are at all intensive; their stimuli put them in intimate relation to the total state of the nervous system. Moreover, instinctive movement, though it has become mechanised in the course of organic evolution, does not occur so continually, in the life of the animal, as does reflex movement. It occurs at critical periods, which are so far the same for all members of a species that mechanisation is useful, but which, just because they are critical, are separated by intervals of greater or less duration. In these intervals other types of action suffice for the needs of the organism.

The true instinctive movement has no conscious condition. But it is clear that when a certain instinctive movement has been a few times performed, every later repetition of it will have definite conscious antecedents. Human instinctive movement, performed in adult life, always has a conscious condition, consisting of the ideas of object, result and movement. At this point we have instinctive *action*. The 'instinct'—that is, the conscious condition of the instinctive movement—is formally indistinguishable from the 'impulse': each consists of attention to the same three ideas. The sole introspective difference between instinctive and impulsive action is the greater intensity and larger number of the organic sensations which accompany the instinctive movement. We must add to this, however, a difference brought out by comparative introspection: the difference that instinctive action is often performed, in obedience to biological laws, in the face of opposing impulses.

We find instinctive *action* even in animals. Thus when a bird comes to build its nest in the third year, it almost certainly has some memory, however vague and fragmentary, of the pattern of

last year, of the movements of nest-building, and of the results which followed. These three ideas, all pleasant, will form the conscious condition of the instinctive actions of this third year.

As instances of human instinctive action we may take hunting and competition. When a man goes out duck-shooting, he has an idea of his object, of his movements and of the result at which the movements aim. Now he may think, on reflection, that the object is insignificant, that the movements will be made under very unpleasant circumstances, and that the result is problematical: yet he goes, and enjoys himself. He goes, in obedience to the instinct of pursuit; he enjoys himself, because instinctive movements are pleasant.

In a case like this, we clearly see the instinctive nature of the action, and the appropriateness of the current definition of instinct as 'blind desire,' — desire with the end omitted. For the antecedent ideas in consciousness are unpleasant: yet a movement *towards* follows them. The nervous mechanism works automatically. Had the conscious antecedent been an impulse, the following movement would have been movement *away.* In the case of rivalry (emulation, competition) there is no such clear difference. The action might be regarded as impulsive, were it not that we can trace its development from the fighting instincts of the lower animals.

It is important to grasp the fact that the 'instinct' comes later than the 'instinctive' movement. We never have impulsive action without impulse (the conscious condition). The first instinctive movements, on the contrary, are made without any conscious condition, without any preceding 'instinct.' The instinct takes shape when we have had some experience of instinctive movements and their results: only after this experience do we get the full process, 'instinctive action.' This fact alone would be enough to differentiate the two forms of action, impulsive and instinctive, even if introspection of the adult consciousness showed no difference at all between the two experiences.

No satisfactory list of human instincts can be made out. Besides the two mentioned, the instincts of pursuit and of rivalry, we

may instance the instinct of speech, which shows itself even in deaf-mutes, and which is normally reinforced by the impulse to imitation; the play-instinct, which in animals always takes the form of mimic combats; the instinct of inquisitiveness, which perhaps had its origin in apprehension of the unknown (*cf.* § 70); and the acquisitive instinct, which probably arose under the biological necessity of storing up a supply of food for the winter months.

§ 68. **Selective, Volitional and Automatic Action.** — Impulsive and instinctive actions are possible only so long as the attention to their antecedent ideas remains passive. Action which is conditioned by active attention is termed selective or volitional action.

(1) *Selective* action arises when we have in consciousness the materials of two different impulses, — when two compound ideas of object and result are both alike supplemented by the idea of one's own movement, and the attention oscillates from the one to the other. A friend meets me on the street, and says: 'Come out for a walk!' I have now in consciousness the impulse to walk and the impulse, previously formed, to go home and work. There is a conflict of impulses, and action follows when one of the two has gained the upper hand over its rival. — Selective action, then, stands to impulsive precisely as active attention stands to passive.

It follows from this that there will usually be more *effort* in the experience of selective action than in that of impulsive; active attention means more effort than passive (§ 38). The conscious conditions of the two movements also differ considerably in composition: 'impulse' is a simultaneous association of three ideas, one of which (the idea of result) is pleasant, while the other two (the ideas of object and of movement) may be either pleasant or unpleasant; 'choice' or 'selection' presupposes alternate atten-

tions to two such associations, accompanied by the sentiment of doubt or mood of indecision (§ 90).

The impulse which wins is the impulse which is favoured by mental constitution, the impulse whose cortical excitations are reinforced by a bodily tendency (§ 35). The parallel between the victorious impulse, in selective action, and the victorious idea, in active attention, is so close that no more need be said here about selective action in general.

(2) *Volitional* action arises when we have in consciousness two sets of ideas, which are both strongly pleasant or unpleasant, but one of which is supplemented by the idea of our own movement while the other is not. The conflict is now not between two impulses, but between an impulse, on the one hand, and attention to a set of ideas which do not suggest action of any kind, on the other (§ 69). Which complex gets the upper hand, — whether action or no action results, — depends upon the capacity of each to hold the attention. Thus I hear my alarum-clock, and have the impulse to get out of bed. The impulse is opposed by the idea of another half-hour's sleep. If the impulse-ideas, the ideas of the time, of my day's work, etc., can hold the attention, I get up.

(3) Just as active attention may become passive, — when, *e.g.*, we grow 'absorbed' in the problem before us, — so may a selective or volitional action pass into *ideo-motor* action, and thence into a reflex-like form, which is termed *automatic* action. Some particular impulse may habitually gain the victory over its rival impulses, or over the ideas which compete with it for the attention. When this is the case, the idea of movement, contained in the impulse, and the organic sensations aroused by actual movement, gradually cease to attract notice: the whole

movement becomes indifferent, and is relegated to the lower nervous centres for guidance. In the earlier stages of the degenerative process, however, the action (ideomotor) differs from reflex action in the fact that the ideas of object and result do not entirely lapse from consciousness. I look out of window and see the postman approaching, and say: 'I'll go down and get the letters.' The movement of walking follows upon attention to the ideas of object (postman) and result (letters); it is itself performed quite automatically. Or a practised piano-player sits down to play a score at sight. He has the idea of the score, and some idea of the result of his playing (he knows that the composition is a march or a sonata); but the movements of hands and fingers are automatic.

At a later stage the whole action becomes automatic. While I am writing, I dip my pen into the ink time after time, without having any idea of the ink-bottle, of the result of my dipping, or of the movement. So with walking: walking was originally a volitional action, but is now completely automatic.

Automatic actions of this latter kind are true reflexes, — reflexes which have taken shape from selective or volitional actions within the lifetime of an individual. They are sometimes called 'secondary reflexes,' the adjective 'secondary' serving to mark them off from the reflexes which have been formed from impulsive actions, during the lifetime either of the individual or of the race.

Most of the actions of our everyday life are of a mixed character, beginning as volitional or selective, but running their farther course as ideomotor or automatic. — The same advantage follows from the growth of automatic action that follows from the passage of active into passive attention (§ 38). The less we have to attend to the unessential, the more time and energy have we to

attend to the essential. As more and more organic functions are discharged by the lower nervous centres, the higher are left more and more free to undertake new duties.

Putting together the results of this chapter, we obtain the following Table of the development of action.

Action upon Presentation.
Action upon Representation.
↑ Impulsive Action.

↓ Ideomotor Action.	↓ Instinctive Movement.	↑ Selective and Volitional Action.
↓ Reflex Action.	↑ Instinctive Action.	↓ (Secondary) Ideomotor Action.
↓ Involuntary Movement (?)		↓ Automatic Action.

The sign ↑ indicates a rise in the conscious scale, the sign ↓ a descent towards unconsciousness.

§ 69. **Inaction.** — Every instance of attention in the primitive consciousness means movement of the primitive organism. So long as consciousness is inattentive, the organism is inactive. The first condition of inaction, then, is (1) a generally inattentive ('scatter-brained') state of consciousness.

(2) Later on, when action upon presentation has given place to action upon representation, voluntary movement does not follow upon attention unless one of the ideas attended to is the idea of one's own movement. While the impulsive action is still imperfectly developed, the idea of movement will, it is true, be liable to attach to almost any presented idea: the child stretches out its arms for the moon. Nevertheless, there is now a second possible condition of inaction: the association of the ideas

of object and of movement will be broken up in all cases where the object is found to be unattainable. It soon becomes a matter of experience that reaching after the moon is fruitless, and has no pleasant consequences. Hence the moon-idea ceases to be supplemented by the idea of movement. Impulsive action passes into inaction, because the movement-idea has 'dropped off' certain ideas to which it was once associated.

Inaction may result (3) from a conflict of equally strong impulses. If the impulses to go for a walk and to go home and work (§ 68) were of precisely the same strength, I should be obliged to stand still; I should be inactive, until one of them was reinforced, and so gained the upper hand in consciousness.

An instance of this sort of inaction, so often quoted that it has become proverbial, is to be found in the *Sophisms* of M. Buridan, a rector of the University of Paris in the 14th century. We are asked to imagine the case of an ass, which is hungry and thirsty in equal degree, and is placed just midway between a basket of oats and a pail of water. The impulses in both directions being exactly equal, the animal would starve.

Inaction may result also (4) from the fact that the ideas which rival the impulse are the stronger of the two complexes. When I hear my alarum-clock, I have the impulse to get out of bed. But the idea that I have nothing especial to do, combined with the feeling of present comfort, may overcome the impulse: I stay where I am. — In the first of these instances we have inaction in place of selective action, in the second we have it in place of volitional action.

The last illustration shows that there are certain ideas, in the developed consciousness, to which the idea of move-

ment has never been associated at all. We must suppose that at the period when impulsive action was emerging from action upon presentation, a movement-idea was associated, as a matter of course, to every idea that caught the attention. But the association ceased to be universal as soon as the idea of movement 'dropped out of' certain impulses, leaving them not impulses, but ordinary associations. Henceforth the idea of movement formed connections as other ideas did: it had no advantage over them. And just as we do not associate the idea of 'black' to that of 'grass,' so we do not associate the idea of our own movement to the ideas of 'organism,' 'concept,' 'ocean' and a thousand others. Here, then, is another condition of inaction: (5) we do not act, because there is nothing in the nature of the object attended to which should call up the movement-idea.

Finally, we have cases of pathological inaction (6) in the paralysis of the organism during a violent emotion, *e.g.*, that of extreme terror. There is here no crouching down or running away; all movement is inhibited.

Since in the primitive consciousness every case of attention means the performance of an action, the organism has a strong inherited tendency to movement. Hence it comes that we never attend, never have a clear idea of anything, — *i.e.*, never feel, — without also moving (§ 33). The nervous system is built upon a motor plan; it is never disturbed by an excitation without sending an excitation out again, to some part of the body. If the conditions of voluntary movement are not fulfilled, this outgoing excitation gives rise to involuntary movements; pulse is changed, the viscera move, etc. In the normal man, therefore, inaction, the absence of voluntary movement, does not mean a state of total quietude: whenever he attends (feels), certain of his organs are the seat of involuntary movements.

Our discussion of the psychology of action has inevitably led us into the field of psychogenesis. And we have assumed, throughout, that mind is as old as life; that the one-celled animal has a mind. It should be said here, however, that comparative psychologists differ greatly upon this question. Some (A. Binet, *La vie psychique des micro-organismes*, 1891) attribute to the protozoon a mind that is essentially like the human, though cast upon a smaller scale and in a rougher mould. Others (M. Verworn, *Psychophysiologische Protistenstudien*, 1889) find in its behaviour evidence only of reflex and very rudimentary impulsive action. Yet others (H. S. Jennings, *Amer. Journ. of Psych.*, 1899; *cf.* A. Bethe, *Pflüger's Archiv*, 1898) regard it as merely a reflex machine. It is hardly possible, at present, to decide among these conflicting views. There is nothing inherently improbable, and nothing to tell against our theory of primitive action, in the belief that the protozoa to-day are reflex automata. For, simple as the structure of the animals is, they have had an immensely long physiological past, — their race-history extends back as far as man's. Their originally conscious movements may, therefore, have become stereotyped into reflexes. But we must suspend judgment upon the issue till further observations have been made.

References for Further Reading

Ebbinghaus, *Grundzüge*, I, §§ 68, 69.
James, *Principles*, II, xxiv, xxvi.
Külpe, *Outlines*, §§ 53, 67.
Wundt, *Grundzüge*, II, xx, xxi.
Consult also: J. M. Baldwin, *Mental Development in the Child and the Race*, 1899; H. Münsterberg, *Die Willenshandlung*, 1888; G. H. Schneider, *Der thierische Wille*, 1880; *Der menschliche Wille*, 1882.

PART III

CHAPTER XI

Recognition, Memory and Imagination

§ 70. **The Nature of Recognition.** — Certain objects and processes of the outside world are familiar to us. When their ideas appear in consciousness, they have attaching to them a mark or sign of familiarity, just as pressures at different parts of the body or objects lying at a distance from us in the field of visual space have attaching to them a mark or sign of locality (§ 44). The local sign makes a given cutaneous impression a 'back of the head' impression; the familiarity mark makes that or another impression a 'known' or 'recognised' or 'remembered' impression.

The problem of *recognition*, then, is very similar to that of localisation. We have, in each case, a particular idea or group of ideas which differs from others in the fact that it is marked or ticketed in a particular way. The mark is a conscious process or group of conscious processes; and our business, in each case, is to analyse and reconstruct it, by the help of introspection, and to ascertain its physiological conditions.

Suppose that you are entering a street-car. As you enter, you run your eyes over the line of faces before you. The first half-dozen of your fellow-passengers are strangers; their faces arouse no interest, do not arrest your gaze. At the end of the car, however, you see some-

one whom you know; you *recognise* him. A sudden change occurs in your consciousness; you call him by name, take a seat at his side, and begin to converse with him. — What was it that happened in consciousness, at the moment of recognition? What are the conscious processes involved in 'recognising'?

For one thing, your visual idea of your friend was *supplemented* by a number of other, centrally aroused ideas. As you looked down the line of strange faces, your present train of ideas was not interrupted: the visual ideas were indifferent to you. But as soon as you receive *this* visual idea, a host of other ideas, derived from your past intercourse, flock into consciousness: will the weather spoil the excursion that you were planning? has he solved the problem that was bothering you both last night? did the morning paper say anything about that election? and so on. — The first characteristic of the recognitive consciousness, in this instance, is the supplementing of the given impression by a large number of ideas. Recognition has meant the formation of a highly complex simultaneous association.

At the same time that the association is being formed, your *mood* has changed. As you entered the car you were, we will suppose, thinking indifferently upon your immediate business. When you see your friend, the mood of indifference changes to a mood of pleasantness, which we cannot describe better, perhaps, than by the phrase 'feeling at home.' The mood contains, besides the pleasant affection, a complex of organic sensations, set up by an 'easy' bodily attitude. — The second characteristic of the recognitive consciousness, then, is a pleasurable mood.

Putting the various components together, we have (1)

the presented idea; (2) its centrally aroused supplements; and (3) the mood of 'feeling at home.' The union of these three factors gives us a 'recognition.'

Since the supplementary ideas come to mind in obedience to the law of association, *i.e.*, because certain part-processes are common to them and to the visual idea of your friend, they serve to define the place of that visual idea in your total mental experience. In this sense every such group of supplementary ideas may be termed, metaphorically, a 'local mark'; for it localises the given idea in time and in place. A 'local mark' of this kind, *plus* the 'at home' mood, constitutes the mark of familiarity.—The mood of recognition is a weakened survival of the emotion of relief (fear unfulfilled). To an animal so defenceless as was primitive man, the strange must always have been cause for anxiety (*cf.* the derivation of the word 'fear': § 57). The bodily attitude which expresses recognition is still that of relief from tension, that of ease and confidence.

Every recognitive experience is intrinsically pleasant. Its pleasantness may, however, be outweighed by the unpleasantness of the recognised idea. If the face which I recognise in the street-car belongs to an individual whom I am particularly anxious to avoid, the total experience is unpleasant: an unpleasurable emotion is set up, and the pleasantness of the organic sensations contained in the recognitive mood is forced into the background of consciousness.

§ 71. **The Forms of Recognition.**—While the local signature of visual and cutaneous impressions differs considerably in different consciousnesses, it is always something quite definite, a complex of well-defined sensations. The knowledge that a pressure had been made 'somewhere' on the surface of the body, or that an object was lying 'somewhere' in visual space, would be of little service to us. The local sign, if it is to be of any value, must indi-

cate some particular part of the skin or some particular point in visual space. On the other hand, the familiarity mark — supplementary ideas and mood of 'at home' — may be of any degree of definiteness or indefiniteness.

Recognition will thus have two typical forms, definite and indefinite recognition, — forms which, nevertheless, pass over into each other by a large number of intermediate forms. It is *indefinite* when the sole supplement of the given idea is the word 'known' or 'familiar.' We pass some one on the street, and say to our companion: 'I'm sure I know that face!' Here the familiarity mark consists of the word 'known' and the recognitive mood. Less indefinite are those cases of recognition in which the presented idea calls up a general classificatory term. As we glance down the line of strangers in the street-car, we may think to ourselves: 'Lawyer, — farmer, — commercial traveller.' We have recognised them, indefinitely: the familiarity mark consists of the word 'lawyer,' etc., and the recognitive mood. Lastly, recognition may be *definite;* the supplementary ideas may be so numerous and unequivocal that the given idea calls up quite definite situations and incidents in our past experience. Thus we may be accosted with the words: 'Don't you remember me?' We recognise the speaker, indefinitely, as a University man; but that is all. 'Don't you remember Smith?' Recognition becomes more definite; but we have known several Smiths, and do not yet definitely recognise this one. 'Don't you remember the Smith who was with you on the Brocken in '87?' Now we have a crowd of supplementary ideas, representing incidents experienced in common with this particular individual; the mood reaches its full intensity; recognition is definite.

When we classify recognitions as definite and indefinite, we are thinking of them as already completed. Recognition is definite when the supplementary ideas are definite, indefinite when they are indefinite. We can now classify recognitions, from another point of view, as direct and indirect. In this instance, we are thinking of the way in which recognition is brought about, not of its character as an item of actual experience.

Recognition is *direct* or immediate, when the presented idea is at once supplemented by other ideas, and the recognitive mood at once aroused. It is *indirect* or mediate when the familiarity mark is not called up by the presented idea, but only by some idea successively associated to it.

Thus the recognition of your friend in the street-car is an illustration of direct recognition. You no sooner see him than the supplementary ideas are flocking into consciousness, and the recognitive mood is in course of formation. The recognition of Smith, on the other hand, is an indirect recognition. The first vague supplements of the visual idea do not enable you to recognise it as the idea of an old acquaintance; you would have passed by, without knowing that you had met a former friend. The verbal (auditory) idea 'Smith' is now associated to the visual idea, and the visual-auditory complex has new supplements. Still recognition is not definite. The verbal ideas of 'Brocken' and '1887' are now further associated to the visual-auditory complex; the new complex has many supplements, and starts a definite train of ideas, — recognition is complete.

If we reduce the process of indirect recognition to its lowest terms, we get the following formula. We have an idea, *abc:* say, the visual idea of a person. At first this idea stands alone in con-

sciousness; it does not call up other ideas. Then it is supplemented by other ideas, *xyz*: say, the auditory complex 'I was with you on the Brocken in '87.' Among the supplements of *xyz* are the ideas of the walking-tour to which they refer, *pqr*, and of our friend, as he was then, *bcd*. Here, then, is a successive association of ideas: *abcxyz* gives place to *xyzpqrbcd*. The recognitive mood attaches primarily to the common elements, *bc*; it is extended to the remaining element *a* (a beard, or grizzled hair, or a different mode of dress) simply because this element is given in connection with *bc*. We should not have recognised *abcxyz* except by way of the idea *xyzpqrbcd*; the recognition is indirect.

§ 72. **Recognition and Direct Apprehension.** — In course of time, as we know, the affective processes in emotion may become so far weakened that the emotion passes over into a mood. With still further repetition, the affective processes in the mood disappear altogether, and we are left with a 'mood of indifference.' The recognitive mood of 'feeling at home' is no exception to the rule; its pleasantness wears off, and its organic sensations, becoming indifferent, are disregarded.

Thus we do not 'recognise' the clothes which we put on every morning, or the pen with which we are accustomed to write: we take them for granted. When familiarity has gone thus far, — when the familiar has ceased to call up supplementary ideas and to be pleasant, — we say that recognition has become *direct apprehension*. We directly apprehend our pen as our pen, and our clothes as our clothes, without any intermediation of centrally aroused ideas or of the recognitive mood. Direct apprehension, that is, is a recognition which has become automatic and mechanical; it stands to recognition very much as reflex stands to impulsive action.

At the same time, it does not seem true to say that such

apprehension has no psychological conditions of any kind, that there is no conscious apprehension mark belonging to the ideas of pen and clothes. The organic sensations which formed part of the original recognitive mood are disregarded; but they have not altogether disappeared from consciousness. They are present, weakly and vaguely, whenever we directly apprehend; so that if we describe the pleasurable mood of recognition by the phrase 'at home,' we may say that direct apprehension has a special mood of indifference, best described, perhaps, by the phrase 'of course.'

Introspection of the consciousness of direct apprehension does not reveal any trace of centrally aroused, supplementary ideas. It is true that the sight of pen and clothes evokes certain movements. But these do not involve the idea of movement; they are secondary reflexes (§ 68). And my apprehension of the picture which always hangs upon a particular wall in my study does not even evoke a movement. This apprehension, therefore, seems to be brought about solely by the aid of the 'of course' mood. What we called the 'local mark' has wholly vanished.

On the other hand, we have good evidence of the presence of the mood. Introspection bears out the statement that when we apprehend directly we have, besides the idea apprehended, a vague complex of organic sensations which proceed from the bodily attitude assumed in face of the 'of course' impression. These sensations are best observed on occasions when our apprehension of an object is for some reason prevented. We look at our inkstand, and find that the pen, which we *always* keep in it, has disappeared; or we glance round the breakfast-room, and discover that a picture which has *always* hung upon a certain wall is absent. We have not been in the habit of recognising pen and picture; they are too much matters of course to call up the recognitive mood and supplementary ideas. But now that they are gone, our indifferent 'of course' mood is jarred; and we are

at once on the alert to discover the reasons for their absence. At the moment of jar, at the instant when the attention is caught by the unexpected event, the sensations which make up the 'of course' mood are plainly apparent; but their clearness is hardly more than momentary.

§ 73. **The Investigation of Recognition.** — Four principal problems are suggested by the foregoing Sections. (1) Is direct or indirect recognition the commoner experience? (2) Can the line of distinction between definite and indefinite recognition be drawn with any degree of sharpness? (3) After how long an interval is recognition possible? (4) What is the importance of verbal association in recognition?

We cannot return any very complete answer to these questions. Experimental work upon them has been begun, but is confined so far to cases of recognition under very simple conditions in particular sense departments.

Method. — (1) Prepare a large number of solutions of odoriferous substances. Take care that the bottles which contain them are all of the same appearance, that the different colours of the liquids are not visible, etc. Let the subject smell them, one after another, and write a description of the conscious processes which each scent sets up. You will be able to check his description by your observation of his facial expression during the experiment; the mood of recognition and the mood of uncertainty give rise to different expressive movements of the facial muscles.

In an investigation made with a series of 62 scents it was found that the cases of direct recognition amounted to 79.5% of the total number. In 44.9%, supplementary ideas of all kinds at once flocked into consciousness; in 27.6%, a definite name was at once associated to the impression; in 7%, the word 'familiar' was the sole associate. The remaining recognitions were indirect.

(2) The written records made by the subject in the experiments just described will, evidently, enable us to classify his

recognitions as definite or indefinite. Experiments upon this question can also be carried out as follows. A series of tones or colours is presented, term by term, to the observer. After a certain interval, a single tone or colour is given, and the subject required to say whether it was or was not contained in the original series, and in the former event what place it occupied there. If he says: 'I had it before, but I don't know where it came,' the recognition is indefinite; if he says: 'It was the third of the series,' the recognition is definite. The number of terms in the series, the order in which they are given, the sense department from which they are taken, and the interval separating the series from the single impression, must all be varied in different sets of experiments. — If the other conditions are kept the same, definite recognition will be found to be uniformly dependent upon the length of the time interval, so that the dependence is expressible by a mathematical formula.

(3) A grey disc, which we will call the standard grey, is shown to the observer, say, for 5 sec. After a given interval, he is shown either the standard grey, or a grey which is somewhat lighter or darker than the standard, and required to say whether or not it is the same as the standard. The time interval is increased until mistakes begin to be made; and the amount of error which each increase of interval brings with it is noted by the experimenter.

(4) There can be no doubt that verbal association is extremely important for recognition. Experiments can best be made by a method similar to that described under (2) above.

Prepare two series of discs, of different brightnesses. Each series must begin with white and end with black, but one is to contain five terms in all, and the other nine. The difference between every successive pair of greys must be the same for sensation; *i.e.*, you must choose your discs in accordance with Weber's law (§ 27).

Present a series to the subject, going in regular order, from black to white or white to black. After a brief interval, show him some member of the series, taken at random, and ask him what place it occupied in the original series. As long as you test him

by the 5-series, he will make no mistakes; he is able to remember the discs by the verbal associations 'black,' 'dark grey,' 'grey,' 'light grey,' 'white.' But when you take the 9-series, he is constantly making mistakes; he has no verbal association to guide him.

You can convince yourself that it is really the verbal association which is doing the work of recognition by the following variation of the experiment. Show the series of nine brightnesses, and name each disc as you show it: 'one, two, three,' etc. The observer's mistakes at once decrease; he recognizes a given grey not by any grey-name, but by help of the number-name 'four' or 'five.'

§ 74. **Recognition and Memory.** — We have seen that the recognitive consciousness consists of three sets of processes: a presented idea, the centrally aroused supplements of this idea, and a mood. So far as it is composed of sensations and their derivatives, we have in it a simultaneous association of ideas.

Simultaneous associations of ideas may be of three kinds: associations of peripherally aroused ideas, of centrally aroused ideas, and of peripherally and centrally aroused ideas. An association of the first kind does not occur in the developed consciousness, except in the form of a direct apprehension; no complex of objects shown to us for the first time can be so utterly unknown and strange that it is not indefinitely recognised as a 'machine' or 'some sort of a plant,' etc. When you are shown a seismograph tracing for the first time, you may be wholly unable to see what it represents; but at least you know that it is a scrawl, a tracing of some kind. An association of the second type, which is accompanied by the recognitive mood, is termed a 'memory.' The name 'recognition' is applied only to associations of peripherally and centrally aroused ideas.

A *memory*, then, is a centrally aroused idea, centrally supplemented, and attended by the mood of 'at home.' The memory consciousness is the recognitive consciousness, with the single difference that the principal idea, the idea remembered, is of central origin. We have now (1) to examine the nature of the centrally aroused idea, and note the points in which it differs from the peripherally aroused, and (2) to enquire into the conditions of the central arousal of complex mental processes.

§ 75. **The Memory-Idea.** — If we have witnessed a bad accident, we are 'haunted' for some little time by mental pictures which represent it; the scene keeps repeating itself before our mind's eye. And we come home from the hearing of a light opera with 'our head full' of airs; they sing themselves to our mental ear, whether we will or no.

In instances like these we have the most primitive form of the *memory-idea*. The memory-idea is orginally a sort of continued after-image (§ 24), an after-image which persists long after the peripheral effects of the stimulus have passed away. It is the mental counterpart of the central (cortical) portion of the total excitation set up by the stimulus.

The memory-idea, at this stage, does not differ in quality from its peripheral predecessor. The pallor of the injured man's face, the colour of his clothing, the blood issuing from the crushed limb, are all branded upon consciousness, and remain what they were. The memory-idea is, however, less intensive, less clear in outline, and as a rule less permanent than the peripheral. We are not so liable to be sickened by our memory of the accident as we were by the sight of it, however vivid the memory may be; the

details of the scene are less sharply cut than they were in reality; and there is a greater likelihood of the memory being ousted by other ideas, of its losing hold upon the attention, than there was while we were spectators of the actual occurrence. Although, therefore, the memory-idea is, on the side of quality, a representation or *reproduction* of the accident or operatic air, the intensity, duration and extension of its component sensations are sufficiently different from those of its original to prevent any danger of confusion.

But if at first the memory-idea gives a photographic reproduction of the qualities which it represents, it soon begins to lose its qualitative accuracy. It is thrust out of consciousness, and brought back again; it is overrun by other memories; it forms connections with a host of other presentations. It is no wonder, then, that as time goes on it becomes very dissimilar from its original. Indeed, if our memories were composed exclusively of reproductions, they would be untrustworthy as regards events which had occurred even within a few days of their recall.

Fortunately, however, the fact that every idea in consciousness tends to form connections with other ideas, — a fact which might have been the ruin of memory, — proves to be its salvation. A consideration of two points will make this clear. (1) Every experience, however complex, can be expressed by a number of words, a verbal description. Now we have seen that verbal association is one of the most important forms of simultaneous association; the associated word or words put the seal of finality upon the experience. And the word-idea, the visual, auditory and tactual complex (§ 53), is a relatively stable idea; it is one of those mental processes which

have come to be used for the sake of what they mean, rather than for their own sake; its intrinsic interest has entirely worn off (§ 56). Hence it comes about that the word-idea, which originally served to clinch a simultaneous association of other ideas, tends to replace these ideas; our memory of past events is very frequently nothing more than the reproduction of the form of words which we have associated to them; we say that we 'remember' hearing Patti sing twenty years ago, when all that we really remember is our own statement of the fact. (2) Every mind has, in virtue of its special constitution, a tendency to the formation of connections in one sense department rather than in others. Although we could localise a pressure upon the back of the head either by organic sensations or by a visual picture of the part touched, most of us do, as a matter of fact, use the visual picture. The ordinary consciousness is dominated by visual ideas (*cf.* §§ 4, 7, 16, 21, 43, 44); the average man and woman think only of how they look, not of how they sound, or of how their favourite perfume may offend the noses of their fellow-men. Indeed, the word 'idea' (form, image) bears sufficient witness to the fact, and further evidence is furnished by the phrases: 'Just *imagine!*' '*Figurez* vous!' and '*Stellen* Sie sich *vor!*'

When our memory of a past event is reproductive, then, —instead of being merely verbal,—it will be reproductive, as a general rule, upon the visual side; the auditory, olfactory, gustatory and tactual reproductions will, if they appear at all, be quite vague and wholly subordinate to their visual associates. Less frequent is the occurrence of an auditory or tactual type of memory, of a consciousness dominated not by vision but by the ideas

of hearing or touch. Memories of this kind have, however, been described; and their existence follows naturally from the known differences of mental constitution.

It is to be noted that the predominance of one kind of memory, the preference given to connections within a single sense department, is rarely carried so far that no other memories are at the disposal of consciousness. However strong one's tendency to visual thought, it is not probable that one will read a book entirely by eye, without faint auditory reproductions (words heard) and weak innervations of the muscles of the larynx (words spoken). Many people who have a definite leaning in, say, the visual direction, are nevertheless able, when occasion arises, to think in terms of hearing and touch; and these supplementary memories are susceptible of great improvement by education and practice. We must, therefore, recognise a 'mixed' memory type, alongside of the visual, auditory and tactual.

A 'mixed' memory is, obviously, of greater practical service to its possessor than a 'pure' memory. In the first place, more aspects of the physical world can be reproduced in consciousness, *i.e.*, memory is more complete; and secondly, what is remembered is remembered in more ways, *i.e.*, memory is more reliable. Just as we 'hear' a lecturer better if we keep our eyes upon his face, so we remember an event better if various senses are called upon to furnish the idea which reproduces it.

We have a good instance of the customary predominance of vision in the fact that dream-ideas are almost exclusively visual. The organic sensations attending an indigestion are translated, as it were, into the visual picture of a monster seated upon our chest; the pins and needles of a cramped arm are translated into the picture of an acquaintance who nips us with a pair of pincers, etc.

Since the raw material of memory-ideas consists, in every case, of centrally aroused sensations, it is natural that memory should obey Weber's law in every instance where the law holds for the corresponding peripheral sensations. Thus our memory for bright-

nesses is *relative;* the distribution of light and shade in a painting is accepted as a correct representation of reality, although the landscape painted was, absolutely, very much brighter than anything on the painted canvas can be. Our memory of a melody is also relative (§ 50); we recognise it, as it is now played, although it may be played in a different key from that in which we have heard it rendered on former occasions. On the other hand, our memory for colours is *absolute.*

§ 76. **Retention.** — An idea is formed, in correspondence with an object or process of the outside world. It lapses from consciousness, to be recalled after a certain interval. What becomes of it in the meantime?

So long as the idea was regarded as a permanent 'thing,' an unchanging 'bit' of mind, there could be but one answer to this question. The idea must be somehow conserved, retained, from the time of its formation; it is laid away, unregarded, in the outermost fringe of consciousness; but it still persists, as a conscious fact, only waiting its time to attract the attention and come to the front again.

We have rejected the view that the idea is a thing, and have regarded it always as a process, a becoming. But even if we had not, we should be unable to obtain from introspection any warrant for the view that the mind is a storehouse, containing all the ideas which have at any time formed part of our experience. (1) There are many occasions when we wish to remember an event or a name or a date, but cannot do so; when we cannot find the desired idea, search consciousness as closely as we may. If the idea were there, it would surely be discoverable. (2) Consciousness is complex enough; but there is no evidence that it is so enormously complex as the theory

would require. We can hardly imagine what would be the complexity of the adult consciousness, if every single conscious process had to be stored away. In other words, the fact that we forget is as indubitable as the fact that we remember. Some events never are remembered. (3) The fact that we forget may be brought out in another way. If all our ideas were retained by consciousness, we should have a complete panorama of our past life; we could pass from idea to idea without a single break. The adult reader will need very little introspection to assure him that his memory is really fragmentary, that there are great gaps in his reproduction of past experience. A diary written forty years ago will speak of incidents which cannot be reconstructed; and the friends referred to familiarly by their initials will have dropped out of mind so completely that the letters are entirely meaningless.

There is no such thing as mental retention, the persistence of an idea from month to month or year to year in some mental pigeon-hole from which it can be drawn when wanted. What persists is the tendency to connection (§ 55). The view from my window reminds me of a certain Swiss landscape. It may be that certain visual qualities or arrangements presented by it were also presented by the Swiss landscape; it may be that the form of words which I use to describe its beauties is in part the same as that which I use to describe the Swiss scene. In either case, the idea of the Swiss landscape is formed *afresh*, *re*-formed (under the general conditions of associative supplementing), whenever it is suggested by a glance from my window. Certain elements in the given idea or its supplements have formed certain habits of connec-

tion; and these tendencies to connect are realised under favourable conditions. The idea of the Swiss landscape is 'available' (§ 53); but I do not keep it by me, ready made.

When the connection is formed, I have the recognitive mood; I recognise parts of the view as parts of the Swiss landscape, and feel at home in regard to them. — How definite the recognition is, in a particular case, will depend upon circumstances; I may have simply the indefinite idea that I have 'seen something like this view before.'

'Nevertheless, there must be retention somewhere,' the reader may object; 'for how could the tendency to connect persist without it?' The objection is valid. But we must look for retention not in consciousness, but in the physiological processes which constitute its condition. The cerebral cortex is retentive. When a certain group of cells has been exploded in a certain way, it retains a disposition to explode again in the same way; every exercise of nervous function leaves behind it a *functional disposition.* The Swiss landscape cells, having been all exploded together, are disposed to explode together again, when any one member of the group is exploded by a present stimulus. The strength of the functional disposition in a particular case depends upon practice, *i.e.*, the frequency of common functioning in the past, and upon bodily tendency.

§ 77. **Memory and Direct Apprehension.** — We have seen that a peripherally aroused idea, if it is of frequent occurrence, ceases to be recognised and becomes directly apprehended. Its central supplements drop off, and the 'at home' mood changes to the 'of course' mood.

We have a precisely parallel process in the case of memory. A centrally aroused idea, if it is of frequent occurrence in consciousness, ceases to be remembered, and becomes directly apprehended. Its central supple-

ments fall away, and the recognitive mood gives place to that of direct apprehension.

We solve a geometrical problem, *e.g.*, by the help of definitions, axioms, postulates, and the results of our solution of previous problems. As we work, these postulates and previous solutions *occur* to us; their ideas are centrally aroused. But they need not bear the memory mark: they need not be supplemented by the ideas of the book from which we learned them, of our early struggles with their difficulty, of the schoolroom, of the master who taught us, etc., and they need not bring the mood of familiarity with them, — they may be matters of course. Under these circumstances we must call them not memories but direct apprehensions.

§ 78. **The Investigation of Memory.** — The experimental investigation of memory, like that of recognition, is still in its first beginnings. Three problems suggest themselves. (1) How shall we determine the subject's memory type, and how educate his less developed memories? (2) How long does a reproduction retain its quality, *i.e.*, resist the influence of the other contents of consciousness, and remain what it originally was, an exact photograph of a physical object or process? (3) What is the range of memory; *i.e.*, how many connections can be formed in a given time?

No one of these three questions has been satisfactorily answered, though something can be said upon each topic.

Method. — (1) The best way to determine memory type is to examine one's memory-ideas introspectively, to ascertain what one's memory of a given event actually is. This method, however, can be safely used only by a highly practised and impartial observer. Consciousness must be taken 'off its guard,' at all

times and seasons, and all sorts of memories scrutinised. It is important to note not only what has been remembered, but also what has been forgotten: the subject must imagine the total event, which his memory represents, and see how much of the imagination is indicated by the memory.

Another method is that of *description*. Write out all that you remember of an occurrence, and go over your description carefully, noting what kind of incidents are recalled (things seen, things heard, etc.), and what omitted.—Something may also be done by judicious questioning, by the method of *suggestion*. Suggest some familiar event to the subject, and note how accurately he is able to reproduce it. Introspection by the subject himself will be of great assistance here.

A rudimentary memory can best be trained by the method of *reproduction*. If the subject has a poor visual memory, show him series of simple visual designs, and let him reproduce them on paper after a brief interval. As his memory improves, the complexity of the designs must be increased, and the interval lengthened. If he has a poor auditory memory, let him have passages read aloud to him, and attempt, after a given interval, to repeat what he heard. If he has a poor tactual memory, let him practise a finger-exercise upon the piano keyboard, until his fingers run 'of themselves'; or let him close his ears, and repeat some familiar sentence aloud, until he has the 'feel' of the words in his throat. The attention must, of course, be concentrated as exclusively as possible upon that aspect of the stimulus which it is desired to remember.

(2) The method of *comparison* is the best for testing the qualitative accuracy of memory. The subject calls up a memory-idea, visual, auditory, or what not, and when it has become quite clear in consciousness, is asked to compare it with a given impression. The impression is something which more or less nearly resembles the object which the subject's memory-idea represents.

(3) The range of memory may be tested as follows. Prepare a number of nonsense syllables, each consisting of two consonants and a vowel,—say, 1000 in all. Form series, quite at random, making the series of different lengths: 5, 10, 15, etc. Read a

series aloud, repeating the reading until you can say the syllables through 'by heart.' Note the time, *i.e.*, the number of repetitions, required for the memorising of the different series. Care must be taken to read always at the same rate, in the same rhythm, and with the same degree of attention.

You will find that, with fairly short series, the range of memory is proportional to the time spent in memorising, *i.e.*, to the number of repetitions. The longer you take to learn, the oftener you go over the series, the better you remember.

The investigation of memory is rendered peculiarly difficult by the fact (§ 75) that our memory of an event is not a reproduction, an exact representation of it. For practical purposes, we may congratulate ourselves that memory-ideas, like words, come to be attended to not for what they are in themselves, but for what they mean. Even when they are, in part, reproductive (as we assumed in our discussion of Retention, and as is the case when we recall a scene by visual memory, or an air by auditory), the reproduction is exceedingly incomplete, and is attended to not as a reproduction but as a symbol of a total experience. But when we set to work to examine memory, by psychological methods, we are at once confronted by the question: What is the particular symbol, reproductive, verbal, etc., which this particular subject employs in his memories? Until this question has been answered, — and its answer is by no means easy, — further investigation is impossible.

It follows from our description of recognition and memory that we cannot recognise and remember an *affection*. We can, of course, recognise and remember an idea of affection (§ 59). But when we wish to revive a pleasantness or unpleasantness we do so by fixing the attention upon the ideas to which it attached: we call back the (pleasant or unpleasant) 'situation.'

It has been found by experiment that the memory-ideas which represent the original experience are, for some subjects, accompanied by the affection which coloured that experience, while for others they are entirely cold and colourless, no matter how intensive the pleasantness or unpleasantness of the experience may have been. Hence it has been suggested that psychology must recognise, not only the various types of sense-memory (visual, auditory, etc.), but also an *affective* memory-type. In reality, the two classes of subjects are distinguished, not by the power or lack of power to recall affection,—for no one can recall an affection,—but by the presence or absence, in memory-complexes, of organic (and more especially of visceral) sensations. When a boy is flogged at school, he has, besides the pain of the flogging, all sorts of anticipatory and subsequent stirs-up of organic sensation,—flutterings, sinkings, breath-catchings, nauseas. If, when he recalls the flogging in later life, the cortical excitations that underlie his memory-ideas revive the splanchnic, etc., excitations that constitute the stimuli to organic sensation, then the scene comes back to him with its original unpleasantness upon it. If, on the other hand, he merely images the scene, and the organic sensations are not set up afresh with the act of recall, then the memory is 'purely intellectual,' uncoloured by affection (*cf.* p. 226).

The phrase 'affective memory' should, then, give way to the phrase 'organic memory.' A mind's memory-type may be predominantly visual or auditory or tactual (the individual may be eye-minded or ear-minded or motor-minded), or it may be mixed; and each of these four types may or may not be 'organic' as well. A difference between the organic and the other types should, however, be carefully noted. The reproduction of a visual, auditory or tactual perception means the arousal of a visual, auditory or tactual idea: the reproduction of the organic sensations means the literal re-producing of them, their production-over-again. Organic sensations *may* be revivable in idea; the question is doubtful. But, if such revival ever happens, at any rate production-anew comes with it and overshadows it. Hence the organic sensations of 'organic memory' are peripheral sensations · the phrase 'organic memory,' though far better than 'affective

memory,' is itself not wholly correct. Perhaps we should speak of visual, etc., 'reproduction,' but of organic 're-experience.'

We cannot say what proportion of mankind are subject to organic re-experience. It would seem that as a rule, at least among educated people, reproductions are so fragmentary, and the new connections which their part-processes have formed so numerous, that 'affective revival' cannot play any great part in the make-up of consciousness. Oftentimes, indeed, an affection will change, in memory, to its opposite quality. If our reproductive ideas of school-punishments bring into consciousness ideas which have become associated to them in our subsequent life, the unpleasantness may not only have passed into indifference: we may smile as we recall our sufferings,—and unpleasantness has changed to pleasantness. It is probably experiences of this sort that have given rise to the fallacious aphorism that our "school-days are the happiest of our lives."

In Chapter VII we refused to make any distinction between the perception and the idea. It may now occur to the reader that the refusal was ill-advised; that to distinguish recognition from memory we have been compelled to distinguish the peripherally aroused from the centrally aroused idea; and that it would make our psychology easier if we said that perceptions were recognised and ideas remembered.

As a matter of fact, it is just because the distinction is of practical importance only, and not of scientific value, that we refused to make it. Practically, in everyday life, there is a difference between the recognitive and the memory consciousnesses; scientifically, there is no difference. No centrally aroused idea, that is to say, is intrinsically a memory-idea: its qualities are the qualities of peripherally aroused ideas, and its mode of formation does not differ from theirs. It it only in virtue of a certain function or meaning that it becomes a memory-idea.

It might be well, perhaps, to reject the term 'memory' altogether, and to speak only of recognition. But 'memory,' like the phrase 'association of ideas,' has been employed by psychology for so many centuries, and is rooted so deeply in popular thinking,

that we can do no more, at present, than give a psychological analysis of it, and emphasise the fact that it is not a specific mental process or mental faculty.

§ 79. **The Nature and Forms of Imagination.** — Psychologists distinguish two forms of imagination: the reproductive or passive, and the productive, active or constructive.

(1) *Reproductive Imagination.* — No idea can enter the adult consciousness for the first time without being in some way supplemented. There must be part-processes in it which, as constituents of other ideas, have formed habits of connection. We speak of reproductive imagination in cases where the supplementing of a new idea is a reproductive supplementing, a supplementing in kind. I read a traveller's description of an African forest, and *picture* the forest as I read; or I receive the score of a new opera, and the music *sings* itself to me as I run my eye over the printed notes. The visual ideas of the forest are derived from the memories of forests which I have actually seen; and the auditory ideas are aroused because the printed notes have, from past experience, definite connections with musical sounds. But the total experience is neither a memory nor a recognition. I have neither seen the forest nor heard the opera; and though the reproductions have the recognitive mood attaching to them, the central ideas, the printed pages, have not.

Imaginations of this kind are only possible in consciousnesses whose corresponding *memories* are in part reproductive. If my reproductive memory is exclusively auditory, I cannot picture the African forest, though I can imagine its mysterious noises. If my reproductive memory is exclusively visual, I cannot imagine how the opera sounds.

It is to be noted that memory-ideas, especially if they are verbal, may have among their supplements reproductive ideas which are really imaginative, though introspection would regard them as true memories. When I say 'I heard Patti sing twenty years ago,' the form of words may be all that I remember. But as I think or utter the words, they arouse in my mind ideas of a stage, of the singer, etc., so that there is every appearance of a visual memory. The visual ideas in this case are not reproductions of the original scene; they are a new construction of it, suggested by the words. It is impossible to distinguish this 'secondary reproductive memory' from the true reproductive memory, unless we can compare our ideas with a more trustworthy account of the event remembered. Thus I may be sure, from 'memory,' that the singer wore a pink dress when I heard her. The form of words has somehow become connected in consciousness with the reproductive idea of a pink dress, and the whole complex brings the recognitive mood with it. My neighbour, however, has positive evidence that the dress was white, and not pink. I have imagined the pink, then; although from the point of view of introspection, the experience is a memory.

(2) *Constructive Imagination.* — The processes which we have so far discussed in this chapter, — recognition, memory and reproductive imagination, — are all, so far as they are composed of ideas, instances of simultaneous association. We may have recognition at different levels of definiteness, in one experience; as in the illustration 'University man' (indefinite recognition), 'Smith' (less indefinite), '*that* Smith' (definite recognition). This whole process may be described as a successive association; and as each of its three terms is accompanied by the recognitive mood, it is tempting to speak of it as *a* process of recognition, and so to make recognition itself a successive association. But as a matter of fact, the experience contains three successive recognitions, each of which is complete in itself. —

We may have, in the same way, a train of memory-ideas: but 'a' memory is a simultaneous association. The same thing holds of reproductive imagination.

In constructive imagination, on the other hand, we have an instance of successive association, — of association after disjunction. Some of the ideas associated may be central and some peripheral, or all alike of central origin.

Thus suppose that a poet desires to give a description of a storm at sea. He has a mass of memory-ideas and of reproductive imaginations in consciousness. His attention turns from one to another of these, selecting the striking incidents, and rejecting those of minor importance. Now it may happen that a severe thunderstorm comes within his actual experience. The presented ideas are taken into consciousness, and worked over by the attention along with the rest. The poem is written after the moving incidents have been detached from their settings, and reassociated by the attention.

The result of imagination here is a poem, a series of successive verbal associations (judgments). Had we taken the inventor, in place of the poet, for an illustration, we should have had as the result of imagination some machine or instrument. This is a closer copy of the associations found within the imaginative consciousness than the poem could be; the poem is a translation of the imaginative ideas, standing to them as a verbal description of the instrument stands to the designer's imagination of it. The process of imagination, however, is the same in both cases: it is a 'thinking' or judging not in words, but in reproductive ideas.

Psychologically, then, there is no difference between the 'imagination' of the poet and the 'thought' of the

inventor. Both consciousnesses alike are composed predominantly of reproductive ideas. The only difference is in the material (printed words or bits of metal) which expresses the associations found among them.

The 'imagination mark' is, plainly, but little different from the 'familiarity mark' of recognition and memory. We have, again, central supplementing and the mood of 'at home.' Only, the memory supplements are placed and dated; their 'temporal and spatial coefficients' are perfectly definite and inexchangeable, — whereas the imagination-supplements are unlocalised in past experience and transferable from perception to perception.

Notice that no centrally aroused idea is intrinsically an idea of imagination. It becomes this, as it may become a memory-idea, in virtue of a certain function and meaning (p. 294).

§ 80. **Illusions of Recognition and Memory.** — Illusory memories and recognitions are of two kinds: we may remember or recognise something which is really unfamiliar to us, and we may fail to recognise or remember something which was once familiar. Both types of illusion are quite common.

Most people have had experience of what is called *paramnesia*, — a 'feeling' that 'this has all happened before,' which continues in spite of the knowledge that the experience is novel. Various explanations have been offered of the phenomenon. The simplest appears to be the following. Certain part-processes of the novel experience are indefinitely recognised; they are vaguely supplemented, and evoke the recognitive mood. The vague supplementary ideas are checked, forced out of consciousness, by the knowledge that the situation has not occurred in previous experience; but the verbal supplement 'familiar' still persists, and carries with it the mood of 'at home.'

On the other hand, we fail to recognise or to remember an impression or situation because we have 'forgotten' it; *i.e.*, because its connections with other ideas, at the time of its presentation, were not often enough repeated, did not attract the attention, did not fit in with our mental constitution, etc. (§ 55). We do not remember the events of our early childhood, partly because our mental constitution was of the 'scatter-brained' type, and no impression held the attention for any long time or with any degree of power, but more especially because they occurred before we had learned to speak fluently, *i.e.*, before they could be fixed in our minds by verbal association, and so constantly repeated in verbal form.

References for Further Reading

James, *Principles*, I, xvi, II, xviii.
Külpe, *Outlines*, §§ 27, 27*a*, 30, 31.
Wundt, *Grundzüge*, II, xvi (§ 6), xvii (§ 5).
Consult also: H. Ebbinghaus, *Ueber das Gedachtniss*, 1885; F. Galton, *Inquiries into Human Faculty*, 1883; Th. Ribot, *Les maladies de la mémoire*, 5th edn., 1888; *The Psychology of the Emotions*, 1897, ch. xi.
See further: W. H. Burnham, in *Amer. Journ. of Psych.*, 1888–1889; H. Höffding, in *Vierteljahrsschr. f. wiss. Phil.*, 1889–1890; A. Lehmann, in *Phil. Studien*, 1888, 1891.

CHAPTER XII

SELF-CONSCIOUSNESS AND INTELLECTION

§ 81. **Self-consciousness.** — A 'self,' in the psychological meaning of the term, is *a* mind; the mind which is given together with an individual body, and whose constitution is determined by that body. My 'self' is the sum total of conscious processes which run their course under the conditions laid down by my bodily tendencies. Selfhood, that is, is the special and peculiar way in which the processes of an individual mind are arranged, in which they hold together or break apart, follow or accompany one another. The meaning of 'self' includes the meanings of 'mind' and of 'mental constitution,' and at the same time makes these meanings very definite: the 'mind' is thought of as consisting not merely of 'ideas,' 'feelings,' etc., but of *these* ideas and *those* feelings; and the 'mental constitution' is thought of not as a general 'reasonableness' or 'sanguineness,' but as the familiar and especial reasonableness or sanguineness of a particular man.

It is the combination of these two meanings in the same word that makes it possible for us to say that every individual is a different self. The raw materials of all normal minds are the same: a certain limited number of sensations and affections. Regarded as minds, then, all normal minds are alike. But regarded as selves, they

differ in two ways. In the first place, no two mental constitutions are precisely similar; the 'shape' of one man's mind (§ 35) is never exactly like his neighbour's. And secondly, though two men may be so far alike mentally that we are obliged to speak of their mental constitutions as the same, — although the bodily moulds in which their mental experience is run are so far similar that we speak of both their memories as 'logical' and both their temperaments as 'phlegmatic,' — yet the concrete processes of which their minds are made up are dissimilar. The fact that they are born at different times, or brought up in different homes, is enough to give the stamp of individuality to the groupings of sensations and affections of which their consciousnesses are composed.

My 'self,' then, is my mind conceived of as working in *my* way. A self-consciousness is a consciousness in which the *idea* of such a psychological self occupies the principal place, — is, as it were, the centre of interest to which all the other components of that consciousness are referred, and from which they receive a special significance. The problem which self-consciousness sets us is, therefore, twofold: How does one come to have an idea of one's own mind, and of the way in which its workings differ from those of other minds? And of what part-processes is the idea of self, as it appears in the normal consciousness, ordinarily composed?

The second question is the easier of the two to answer. There are certain mental processes which come to the forefront of consciousness whenever I think of myself, which are the invariable constituents of a self-consciousness. These processes are various organic and cutaneous

sensations (pressures, pains, temperatures, strains, respiratory sensations, etc.); the visual picture of my body, in some characteristic attitude and dress; and the verbal idea of 'I' or 'my.' The reason for the prominence of these processes is not far to seek. The organic sensations remain, for the most part, practically unchanged, throughout the life of the organism, neither advancing nor degenerating. Very few of them rise to the level of ideas (§ 51); they are not a medium of communication, as sights and sounds are; they are able to attract the attention more exclusively than is usual among sensations, — in other words, they have an unusually strong affective tone, and so are liable to be swamped in feelings (§ 56); they are 'subjective' processes, not representative of objects or processes of the world outside our own body. The visual picture of the body or of parts of it is, also, always with us; we cannot escape from it. And 'I' or 'my' is the verbal associate of both these sets of processes.

It is noteworthy that the two great association centres of the brain cortex (the posterior and anterior association centres of Flechsig) are held together by the sense-centre for touch and organic sensation, the *Körperfühlsphäre*. This fact helps us to understand the importance of what we may call the 'self of organic sensation' for the centralisation or (as it is more usually termed) the 'unity' of consciousness. There should be a continuous line, the line of this organic self, running through the tangle of processes represented in Fig. 1 (p. 12 *supra*), — sometimes focal, more often marginal in its course, but never entirely disappearing.

The remaining contents of the idea of self may vary within wide limits. Thus the idea may be that of the total self, or of some partial self, my national, social or professional self, or my moral, religious or scientific self. Each of these ideas will con-

tain a different group of reproductions, or a different set of verbal supplements; though the core of all — the essential components of the idea of self — remains the same.

The idea of self is rendered exceedingly stable by the constant repetition of the connections among its components. It is further cemented, welded together, by pleasantness and unpleasantness. Those who can recall the dawning of self-consciousness in their own life assert that the experience has its root in an intense pain (organic sensation and unpleasantness) or an intense pleasure. And in the adult life, the self-idea, except when called up for purposes of psychological or philosophical examination, is hardly ever indifferent. It is often coloured by a strongly affective sentiment; perhaps by vanity or pride (pleasant), perhaps by shame or remorse (unpleasant), — according to the circumstances under which it appears. Otherwise, it rests upon a background of affective temperament: one thinks of oneself with self-satisfaction or self-depreciation. In popular parlance, 'self-consciousness' denotes a temperament of this kind, a conceited or bashful disposition.

The idea of self is plainly not an idea in the precise sense in which we defined that term (§ 51). It is rather a complex of ideas and sensations; a simultaneous association, any part of which can be brought into prominence by the attention. Its complexity is shown by the fact that we speak of a self 'consciousness' as well as of the 'idea' of self. Nevertheless, the close connection of its components, and its singleness of meaning, lead us to term it an 'idea.'

Complexes of this sort are sometimes called *aggregate ideas.* We have already had illustrations of the part played by aggregate ideas in the mental life: the complexes which are disjoined by the attention in judgment and constructive imagination are aggregate ideas.

At this point we are met by a new difficulty. An idea is, by definition, the conscious representative of an object

or process of the physical world. Surely, then, our terminology is wrong; for the 'idea of self' seems to be the idea of our inside world. Apparently, we must either give up our definition or admit that the 'idea' of self is not an idea at all.

We may, however, find a means of escape from this dilemma by attempting to solve the first of the two problems set us by self-consciousness: How do we come to have the 'self-idea' at all? If we can discover the way in which this complex is put together, our explanation may help us to decide whether there is any justification for calling it an 'idea' or not. We pass, then, to the first of our two questions.

How do we come to have an idea of our 'self'? — We must remember that the individual human being is born into a society, and passes his life in a society. We obtain an idea of our mental constitution by noticing the differences that exist between those about us, and by hearing from them how they look upon us (§ 35). In the same way, we obtain an idea of our self, in the first instance, from parents, teachers and companions. From the time when we begin to understand the words spoken in our hearing, we are familiar with the term 'mind,' with the fact that minds differ, and with the use of personal names or pronouns to denote the different persons to whom these minds are ascribed. Under these conditions, it is possible to 'objectify' oneself, to imagine how one looks, thinks, acts, etc., as if the self were really something apart, something of the same kind as the objects or processes of one's physical surroundings. When we have an idea of self, the self is, so to speak, projected outwards into the world, and there surveyed. The idea of the

internal world is projected into the external world, and only thus does it become an idea.

We have a parallel to this process of objectifying or projection not only in the idea of mental constitution, but also in that of affection (*cf.* §§ 33, 59).

We said that the solitary botanist of § 35 would never know that he had a leaning to the study of plants, that there was any difference between 'human consciousness' and 'botanist's consciousness.' He would never form an idea of mental constitution. He might, however, — and this is implied in the use of the phrase '*human* consciousness' in that Section, — form some sort of idea of himself. Although he is not in the company of other human beings, he is in that of animals. And we find that primitive man looks upon his whole environment as man-like; that he anthropomorphises, *i.e.*, makes men of, not only his fellow-men, but animals, plants and inanimate objects as well.

The question how the idea of self first took shape, how it arose in primitive society, is one for the anthropological psychologist (§ 5) to answer. It is evidently a different question from that which we have attempted to answer in the text. The child born into a civilised society, finds the idea of self ready-made, in the minds of his elders, and accepts it from them. Our chief concern is with the adult normal consciousness of civilised man, and it would take us too far from our topic if we should try to show in detail how the idea of self first arose. We may, however, note roughly the stages in its formation.

The individual in a primitive society is, as a rule, too closely connected with his family or clansmen to form a very clear idea of his individual self. But he is, and he is looked upon as, an independent centre or source of action. He boasts of his prowess, and his fellows praise him; the tribe wants food, and he has his own place in the tribal hunt or raid; he is skilled in some special handicraft, and the rest resort to him to supply them with its products. Last, but not least, he is named; he has, perhaps, a title

descriptive of his courage or skill, or derived from some striking event in his life, — a nickname, — in addition to his tribal name. All these incidents are, as mental experiences, strongly affective. They give us the materials for the formation of a professional or social self-idea; and it is only a matter of time for this to be refined to the idea of the individual self. Each man *is* a self; his selfhood is brought home to him, sooner or later, as he mixes with his fellow-men or struggles with natural forces, and the self-idea, once formed, is confirmed, as it were soldered together into an indissoluble whole, by pleasantness or unpleasantness.

We may recall here the statement of § 36 that "belief in the activity or spontaneity of mind is almost universal." What has just been said helps us to understand the persistence of this belief; it is as old as man, a belief ingrained in humanity. Indeed, there can be no doubt that if we were called upon to define the 'I' which is the verbal expression of our idea of self, to say what we mean by it in ordinary conversation, we should have to confess that we think, not of the peculiar way in which our mental experience hangs together, but of a *thing*, a permanent and active something which lives within our body and directs its movements. Yet introspection reveals no trace of this 'thing'; and introspection is more worthy of credence than is an unreasoned belief. Fortunately, we need not let ourselves be misled, as psychologists, by habits of thought and forms of expression. The astronomer speaks of a 'sunset,' just as if he were ignorant of astronomy; but his conformity to custom does not interfere with his having an accurate knowledge of the true nature of the phenomenon. Similarly in general conversation, we may continue to use the words 'I' and 'self' in their ordinary meaning; but as psychologists we must put a different interpretation upon them.

§ 82. **Intellection.** — The psychology of sensation and its derivatives is often spoken of as the psychology of the 'intellect.' We have been dealing with the intellect, then, in our discussions of sensation, of perception or idea, of the association of ideas, of memory and imagination, and of the idea of self.

The word 'intellection' is used in the narrower sense, to cover certain intellectual processes, certain associations and the formation of certain ideas, which make their appearance in consciousness only at an advanced stage of mental development. The most elementary form of intellection, in this meaning of the term, is judgment (§ 54). Other intellectual processes, which we have not yet discussed, are conception or the formation of concepts, and reasoning or relating. Further, all intellection involves two processes, which we have described, but not described under their special names: comparison or discrimination, and abstraction.

The older psychology, from which we have received the terms 'association,' 'memory,' etc., divided the discussion of mind into three great chapters, which it entitled Intellect, Feeling and Will, and looked upon each of these chapters as concerned with a mental faculty or power. Intellect was the power to understand; will the power to choose, act, etc. Modern psychology has kept the three terms, but uses them merely for purposes of classification. Thus intellect embraces all those processes enumerated above; feeling covers affection, feeling, emotion, mood, passion, temperament, sentiment; will includes conation, attention, voluntary action.

The 'faculty psychology' may very well be compared with the older 'vitalistic' physiology. The older physiologists believed in a special vital force or power, — the power of living. When a wound healed, it was supposed to heal because the organism possessed enough of this vital force to resist the injury. We should say to-day that life is the general name for a number of complicated physical and chemical processes, not an added principle, a mysterious something over and above them. Similarly, we no longer think of mind as something apart from mental processes, and of intellect, feeling and will as faculties with which this something is endowed. Mind is a sum total of mental processes; and intellect, feeling and will are subdivisions of mind, special groups of the processes contained in the sum.

Language. — Speech and writing are the principal signs, as verbal ideas are the principal medium, of the processes of intellection in the human consciousness. Articulate speech is, of course, peculiar to man, and in the older psychologies is often made the index of a specifically human faculty of 'reason.' The animals are directed by 'instinct,' man by 'reason.'

Modern psychology has to investigate the origin and development of language, and to analyse the speech-processes and estimate the value of the speech-function in the adult mind. — We have spoken, p. 266, of the speech *instinct.* The phrase implies that the movement of speech is originally an impulsive movement. It is, indeed, pretty certain that spoken language has its root in impulsive movements that express emotion.

Language is, at first, *gesture* language. A gesture may 'express' either the feeling-side or the situation-side of an emotion. The wince and brace and bitter look of § 59 are gestures of the former sort, — subjective gestures. Objective gestures are of two kinds: demonstrative and pictorial. *Demonstrative* gesture points towards, directly indicates, the object that excites emotion: we point our finger *at* the thing that has frightened us, or shake our fist *at* the man who has made us angry. *Pictorial* gesture describes the object, whether by a finger-drawing of its outline in the air, or by the reproduction of one of its characteristic features. Thus a deaf-mute gesture for 'man' is the movement of taking off the hat in bowing; a gesture for 'child' is the movement of cradling and rocking the right elbow in the left hand.

Both subjective and objective gestures were associated with vocal calls, movements of the larynx. Subjective speech, however, the speech of feeling, has had but little development; it is still merely exclamatory, interjectory. Objective speech, on the other hand, soon surpassed objective gesture in complexity and usefulness, — just as the eye, though it is younger than the skin, has overtaken the skin in the race for development, and now entirely overshadows its older companion in the mental life.

The finger-drawing of an object in the air is, strictly, a pictorial gesture; the object, as a whole, is pictured by the movement-outline. It is an easy step from this to the characterising gesture,

which pictures a single feature of the object. There is, now, a further and still more important step for language to take: the step from the characterising to the symbolic movement. The deaf-mute *symbolises* truth, *e.g.*, by drawing the finger straight out from the lips, and untruth by carrying the finger obliquely forwards from the mouth. Our own speech is, with the exception of a few onomatopoetic words (hiss, roar, boom, etc.), entirely symbolic.

We cannot here go into the details of linguistic development. We may, however, note that the history of language bears out to the full our statement that natural science precedes mental, that observation and analysis turn first to the external, and only later to the internal (§ 1 *a*). We find, *e.g.*, in the words for the perceptive processes, evidence of a shift of meaning, from without inwards. Thus *see*, Ger. *sehen*, is accordant in form and probably identical in origin with Lat. *sequor*, follow (*cf.* sue, sequent). To 'see' means, then, primarily to 'follow with the eyes.' Ger. *riechen*, smell, and *rauchen*, smoke, are from the same root; and Eng. *smell* is connected with *smoulder*, and Dan. *smul*, dust. To *touch* is originally to pull or draw: *cf.* tug, team, tuck (in the sense of 'draw together' of cloth).—This first shift may be termed a shift of meaning from external to external-internal. Now follows the completion of the process, the shift from external-internal to internal. *Feel*, Ger. *fühlen*, first meant 'touch'; *cf.* Lat. *palma*, Eng. *palm* of the hand. Not till the eighteenth century were the words reserved for the 'subjective,' affective processes. In many languages, again, the words for 'mind,' 'spirit,' etc., are connected with those for 'air' and 'breath.'

§ 83. **The Formation of Concepts.** — We have seen that the typical memory-idea is a reproduction of a previous, peripherally aroused idea; but that it is inevitable, as time goes on, that the reproduction should cease to be entirely accurate. In the first place, lapse of time blurs the outlines and obscures the qualities of the reproduction; and, secondly, mental experience is so complex that the constituents of every idea will have formed connections, more

or less numerous, with the constituents of other ideas. If I had seen a cat for the first time ten years ago, and had never seen another, my present memory of the animal would not be very trustworthy: the image would have faded, the reproductive supplements of the word 'cat' would have grown indefinite. As it is, I see hundreds of cats in ten years; so that my mental picture of that particular cat — unless the animal had certain very striking characteristics — is not a true memory at all, but a reproductive imagination.

It is clear that, other things equal, a blurred reproduction will be more often aroused by a present idea than a very definite reproduction would be. When I see a lion-cub, I am at once reminded of a cat; the reproductive idea of 'cat' is vague enough to be called up by the present idea of the cub. If the reproductive cat-idea had been photographically accurate, the chances of its recall would have been much less. Differences of colour, of form, of attitude, of precision of movement, etc., might well have sufficed to prevent the formation of the connection lion-cub—cat.

A reproductive idea of this kind, a blurred reproduction, which is liable to be recalled by a large number of different ideas, peripherally aroused, is called in psychology an *abstract idea*. It has been compared to what is termed a 'composite photograph.' If we wish to get a typical face, — the typical face of a statesman, or a soldier, or a student, or a consumptive, or a dement, — we photograph a number of individual faces upon the same sensitive plate. Thus the composite photograph of ten students would be obtained by photographing each in turn upon the same plate, giving him one-tenth of the normal exposure-time

required by the plate. As a result, we obtain a picture in which the resemblances are emphasised and the differences slurred. The abstract idea of a cat, on this analogy, is a reproduction in which all the cat-resemblances are emphasised, and all the cat-differences left faint and obscure.

Now there can be no doubt that the abstract idea might take this form in an 'all-round' mind, a mind which was equally well developed in all its sense departments. But it is not the form which the idea does take, as a matter of fact, in the average consciousness. The photographic plate is *impartial;* it gives equal attention, so to speak, to every detail of the picture before it. The organism, on the contrary, is always *biassed;* it gives more attention to some constituents of an idea than to others. My abstract idea of a cat, therefore, is a composite photograph only of those cat-attributes which have caught my attention; it is more like an impressionist sketch of a cat — the sketch of some particular artist, throwing into relief the particular characteristics which have 'struck' him — than like a composite photograph of some hundred cats.

In other and more technical words: the abstract idea takes shape as the second term in a large number of associations after disjunction. A complex is presented: I disjoin it, by help of the attention, — dividing at this or that point, as my mental constitution dictates, — and then rejoin what I have dissociated. The abstract idea is made up of the common elements which have attracted the attention in a large number of complexes.

Thus our abstract idea of 'hotel' (§ 54) is made up of all those processes which represent what our experience has taught us to look upon as the peculiar hotel-attributes. The idea will differ in different minds, since hotel-experiences differ. And our own

abstract idea will vary as our experience broadens. — Thus one abstract idea may consist of reproductions of a monotonous regularity of structure, cold, scant attendance, exorbitant prices: these will be the elements which have attracted the attention in a large number of residences at hotels. Another may consist of reproductions of luxurious furniture, obsequious service, moderate charges: these will be the part-processes disjoined by the attention from a number of total hotel-experiences.

We defined an idea (§ 51) as the conscious representative of a single object or process in the outside world. The idea of self has already forced us to modify our definition a little: that 'idea' is, in strictness, a simultaneous association of ideas and sensations. Nevertheless, we found reasons for letting it pass as an idea (§ 81). The same thing holds of the abstract idea. It is not, in strictness, an idea, but a complex, made up of residua from many ideas: it corresponds not to a single object or process, but to a large number of objects or processes in the outside world. Unfortunately, 'idea' is the only term in current use which we can employ to designate it. It has been proposed to call it a 'recept': we *per*ceive objects, and *re*ceive their salient features into our minds. But it is not probable that this word will oust the phrase 'abstract idea.'

The complex of ideas disjoined by the attention, the 'aggregate idea,' may be symbolic as well as reproductive in character. The *judgment*, *e.g.*, is an association after disjunction in terms of verbal ideas, which are symbols (*cf.* p. 227). The symbolic 'abstract idea' is termed, not abstract idea, but *concept*. The concept, that is, is the symbol which holds a large number of particular reproductive ideas together; as a word, it is the predicate-word which is predicable of a large number of subject-words, the verbal net which binds them all together for the purposes of conscious usage.

Thus the 'I' which is one of the ingredients in our aggregate idea of 'self' is a concept. The 'I' is the link which holds together the various ideas of social position, professional position, scientific attitude, religious attitude, etc., contained in the self-idea.

There are some abstract ideas which would be extremely vague, however accurate the composite photograph of them in consciousness, if secondary associations were not employed to give them definiteness. Take, *e.g.*, the idea of a minute of time (*cf.* § 29). This could be formed only as a composite photograph of all the events which can happen or in our experience have happened within the space of a minute. The photograph would be worthless.

In such cases we are either content with the concept-word, or have recourse to external associations. Thus the author's symbolic ideas (concepts) of a minute and a second of time — the reproductions which carry the meanings of 'minute' and 'second' when the words themselves are not employed — are represented in the accompanying Figure. The visual form *a*, which is the minute idea, is plainly a blurred reminiscence of the seconds' dial of a watch or clock; and the form *b*, which represents the second, is the picture of one of the division-marks upon the circumference of the dial. In this case, an experience in early childhood has determined the form of the conceptual idea for the rest of life. The sign for a 'second of arc' ($''$), learned later than the form of the watch-dial, has not been able to change the single stroke, which first meant a second, into two strokes.

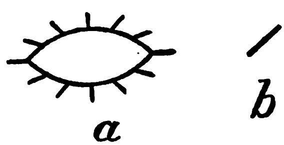

FIG. 9.

There is no lack of experiments to show that the concept-word, the verbal associate of the abstract idea, is the most prompt and ready supplement of a given impression. We have no doubt that a particular impression is a 'sound'; but we may be very doubtful as to its exact nature. We have no doubt that two given impressions are 'different'; but we may be wholly unable to say

wherein their difference consists. We have no doubt that a face is 'familiar' to us; but we may be completely at a loss to describe the circumstances under which it became familiar.

Method. — Set down the points of a pair of drawing compasses upon the skin, as explained in § 44, starting from so small a separation of the points that but a single impression is sensed. Gradually increase the separation, till the two points are distinguishable. You will find at this stage that though the subject is certain of the duality of the impression (general concept), he is entirely unable to state the direction of the straight line joining the two points (more special concept). — In the same way, cutaneous movement is perceived sooner than the direction of the movement; a stimulus is cognised as a light stimulus before its specific quality can be made out, etc.

Pathology confirms our position, showing that concept-words, which are most often associated to given ideas, are also more firmly attached to them than are any other verbal supplements. When memory begins to fail, with advancing age, it is the concrete words which are first forgotten: personal names, particular names of all kinds. Abstract words, concepts, remain longest of all. It is hardly possible to forget that a certain complex of visual stimuli is a 'man'; it is quite possible to forget that it is 'George Smith.'

§ 84. **Reasoning.** — Reasoning is the name given to a successive association of judgments. It is thus the verbal counterpart of the reproductive processes involved in constructive imagination. As total processes, the reproductive associations of the poet or inventor and the verbal associations of the scientific thinker are one and the same: both are a series of associations after disjunction. The difference in the nature of the constituent part-processes, the difference between reproductive and verbal ideas, points simply to a difference of mental constitution.

In every association two ideas are brought into connec-

tion. When the connection itself has become the object of attention, when, *i.e.*, we have formed an idea of connection, as distinct from the ideas which are connected, we speak of it as *relation*. Now reasoning, like the verbal simultaneous association, and like the judgment, has upon it the mark of completeness, of finality. This plainly means that reasoning, as defined above, is possible only when we have among our available stock of ideas an explicit idea of relation; for unless we know a relation when we see it, we may lengthen out our series of judgments indefinitely, on the pattern of a train of ideas, and pass our goal without realising that we have attained it. Reasoning, then, implies an idea of relation; an idea which guides us in our argument, as the idea of movement guides us in the performance of an action.

What are the part-processes contained in the idea of relation? And how is the idea formed? — The idea may be reproductive or verbal. In the former case, it consists of a picture of certain objects or processes as somehow bound or chained or clamped together; in the latter, simply of the word 'relation,' auditory, visual or tactual. The idea is formed very much as the ideas of mind, self and mental constitution are formed. We grow up among people who have the idea of relation; who speak in terms of cause and effect, likeness and difference, substance and attribute, whole and part, etc.

As to the original formation of the idea of relation, in the past history of the human race, we can do no more than speculate. It must be remembered (1) that the relation expressed in the judgment is a relation of parts now dissociated, but originally together in the aggregate idea; and (2) that primitive man looked at everything from an unconsciously anthropomorphic

standpoint. Since in judgment the part is drawn out of the whole, the attribute drawn out of the substance, the effect drawn out of the cause, it may be that a pictorial idea of connection or relation took shape at a very early stage of thought. What a man makes or does '*belongs*' to him; that is, his mind *lengthens* out to it, holds to it, as if by a physical bond. If the clouds are looked on as men who make the rain, the sun as a man who makes the rainbow, etc., this idea of belonging, of being connected, might easily assume definite form. From the reproductive or pictorial idea to the verbal, and from the more concrete to the more abstract verbal idea, are steps of no difficulty.

We have indications of the pictorial origin of the idea in the word 'connection' (Lat. *nectere*, to bind), and in the German 'Beziehung' (*ziehen; cf.* 'tie') and 'Verhältniss' (*halten; cf.* 'hold'). 'Relation' suggests to us that the association is an association after *disjunction* (*re-ferre*, to put back again). 'Association' itself emphasises the *after*, the temporal position of that which is associated (*ad-socius*, from *sequor*, I follow).

§ 85. **Comparison or Discrimination, and Abstraction.** — The *comparison* of two impressions implies three things. (1) We attend actively to the impressions. (2) The ideas which correspond to them in consciousness call up the verbal associate 'alike' or 'different.' Sometimes the association is simultaneous; the word 'crops up,' as soon as the ideas have become clear, — and the act of comparison is at an end. Sometimes the association is successive; each impression is attended to repeatedly, and each judged part by part, — the word coming only after a series of judgments has been passed. (3) Along with the appearance of the verbal associate, a mood is formed. The judgment 'like' is accompanied by the recognitive mood of 'at home'; the judgment 'different' by the mood of vague discomfort, the weakened form of the emotion of alarm (p. 275). Both moods may be ob-

scured or destroyed by the affection attaching to the objects of comparison.

Discrimination is used, in strictness, to express the process which terminates with the verbal association 'different,' but its meaning has been extended to include judgments of likeness as well; so that it is commonly used as synonymous with comparison.

The structural analysis of the process of comparison, as here outlined, is seen to be of a very simple kind. And much exception has been taken to it by critics, on the score that comparison is a complicated matter, found only at the highest stage of mental evolution. But we must not confuse facts of structure and facts of growth. If the reader will test the statements of the text by a trained introspection, he will find that the analysis is exhaustive. On the other hand, the place of comparison in psychogenesis is a high one: for the reason that it presupposes the formation of the concepts of likeness and difference. Verbal association and judgment are, in themselves, comparatively simple processes; but when the word associated or predicated is a fully formed concept, we realise that the simplicity of form is deceptive, that much mental elaboration lies behind.

The character and function of the concomitant moods are also indicative of a long mental ancestry. The finding of a likeness, *i.e.*, the coming upon the known, is always, intrinsically, reassuring and, therefore, pleasant; and the mood has persisted, in some little strength, in the civilised mind. But with the vast widening of human experience, and the ensuring of the safety of the individual within society, 'difference' has almost ceased to imply 'lack of familiarity,' and therefore uneasiness. Many differences are natural, matters of course, and so leave us indifferent; others are expected, looked for, and so themselves take on the mood of recognition. Still, there are occasions when the presentation of differents arouses the true different-mood, the mood of vague discomfort or 'strangeness.'

It is hardly necessary to give instances of the obscuration of

these moods in actual experience. If we are comparing two molluscs, in the hope that one of them represents a hitherto unknown species, and both prove to belong to the same, the recognitive mood may be overcome by the emotion of disgust or the sentiment of unsuccessful thought (§ 90). If, on the other hand, we find on close scrutiny that certain coins or book-plates in our collection, which we have hitherto regarded as duplicates, are minutely different, we may experience the emotion of pleased surprise or of vexation at our former carelessness, or the sentiment of curiosity; but there will be no trace of the original different-mood.

We may compare two peripherally aroused ideas, two central ideas, or a peripheral with a central idea. In the first case, we turn quickly from idea to idea, having in mind at any given moment the actual presentation of the one and a direct reproductive image of the other. In the second, we have in mind, as a rule, a verbally supplemented reproduction of each of the compared ideas, and turn the attention quickly from the one to the other as before. In the third, we have a presentation on the one side, and some memory symbol (word, part-reproduction, etc.) on the other. It seems, from laboratory experience, that we never attempt to compare a presented idea with a complete reproductive picture of another; distrust of the reproduction appears to have become 'instinctive' with us.

Abstraction is the name given to that movement of the attention over a complex of ideas, whereby the complex is dissociated, and certain parts of it are rejoined in a judgment or constructive imagination. We are said to 'abstract from' those portions of the complex which do not arrest the attention, while, on the other hand, the parts lifted out of the whole by the attention are termed 'abstractions.'

Thus an abstract idea is an idea in which we abstract from the unessential features of the aggregate idea from which it is

derived. It is itself an abstraction, because it is only a part of the aggregate idea. The mechanism of the process has been described above (§ 38).

References for Further Reading

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CHAPTER XIII

SENTIMENT

§ 86. **The Nature of Sentiment.** — When we were analysing emotion, we found that its core or centre is made up of a strong feeling, by which the current train of ideas is interrupted. The organism has to face a situation. It does this by way of passive attention; the situation overwhelms it, takes undisputed possession of consciousness. At the same time the body falls into some characteristic attitude; a characteristic group of organic sensations is aroused. And the central feeling is reinforced by a number of associated ideas.

If in our description of this total process we write 'strongly affective judgment' for 'strong feeling,' we have the essentials of the *sentiment*. A situation has to be faced. It is in this case too complex to be faced by way of passive attention; the active attention must play upon it, and a judgment be passed. A 'situation,' as we have seen (§ 59), is a serious matter: the judgment will be strongly pleasant or unpleasant. In either case, it is reinforced by other judgments, concepts, or reproductive ideas; while at the same time expressive movements occur, and give rise to organic sensations.

The sentiment, then, stands to the emotion precisely as active stands to passive attention. It is the total affective

experience which arises when we face a situation by way of active attention, — by means of a judgment.

It is the situation — the materials disjoined by the attention for re-association — which determines the affective quality of the sentiment, as it ordinarily (*cf.* § 59) does that of the emotion. Hence the sentiment may be either pleasurable or unpleasurable. The process of judging is also accompanied by affection : it will be pleasant or unpleasant according as the effort involved in the attention is moderate or excessive (§§ 37, 38). Judgment itself, the completed re-association, is intrinsically pleasant, just as is recognition or instinctive action (§ 70). But its pleasantness is, of course, often swamped by the unpleasantness of the situation.

Active attention frequently relapses into passive. Hence it is natural that the sentiment, which is developed out of emotion, and is characteristic of a higher stage of mental differentiation, should readily slip back into emotion. Suppose, *e.g.*, that I sit down to read a story. At first, I have various æsthetic sentiments : I linger over the beauty of the style, or the harmony of the incidents. I have, too, various intellectual sentiments : I feel that the tale is true to life, that its scenes are self-consistent. But as I read, I grow absorbed, — I cease to be 'critical,' *i.e.*, to be actively attentive. The story takes possession of me, and the writer 'moves' me as he will. Sentiment has been entirely replaced by its simpler counterpart, emotion.

It must not be supposed that every affective experience which can be referred to a judgment is a sentiment. Many of our judgments are not judgments at all in the psychological sense ; they are ready-made formulæ, received from others, not won by any exercise of the active attention on our own part. We are so thoroughly accustomed to throw our mental experience into logical form, that we may think or speak of a situation as if we had judged it, when really it has seized us, taken possession of us, and been 'felt' as a whole, in an emotion. 'Why are you so disgusted?' we may be asked. 'I am disgusted because I have been cheated.' The answer is psychologically misleading. It is not the judgment 'I have been cheated' that forms the centre of the emotion of dis-

gust; it is the feeling set up by the situation. The judgment 'I have been cheated' is due to a reflection upon the source of the emotion; it is the most convenient way of conveying to the enquirer an idea of the reason for the emotion. Here, then, it is quite possible to refer the whole experience to a judgment; and yet the experience is not a sentiment.

There is no rule more essential, and no rule more difficult to follow, when one is introspectively examining a complex mental process, than this: Do not let a judgment about the facts take the place of the facts themselves. It is all too easy to glide into a series of familiar formulæ, which give a rough notion of the experience under investigation. The trained and impartial observer (§ 10) will be on his guard against the temptation, and will arrest himself when he finds that his description is running smoothly, in stereotyped expressions and customary phrases. Every fact requires its own form of words, if it is to be adequately described.

§ 87. **The Forms of Sentiment.** — There are four great classes of sentiments: the intellectual or logical, the ethical or social, the æsthetic and the religious.

The *intellectual* sentiments are the affective experiences which grow up round the judgments 'This is true' and 'This is false, as a matter of knowledge.' The *ethical* sentiments attach to the judgments 'This is good or right' and 'This is bad or wrong, as a matter of my behaviour to my fellow-men or of theirs to me'; the *æsthetic* to the judgments 'This is beautiful' and 'This is ugly'; and the *religious* to the judgments 'This is' and 'This is not sanctioned by divine command, or in accordance with the divine plan for the government of the universe.'

We cannot attempt here to trace the formation of the abstract ideas of 'truth,' 'goodness,' 'beauty,' etc.; we must take it for granted that they have been formed, after the fashion of the ideas of 'self' and 'relation'

(§§ 81, 84). Taking the concepts for granted, we can see how natural it is that the intellectual, moral and religious judgments should be strongly affective processes. It is of the utmost practical importance to know whether facts agree or do not agree with our opinions, whether reports are true or false, whether an action is good or bad, whether our friends will regard our behaviour, under certain circumstances, as right or wrong, whether a line of conduct is approved or disapproved by the supreme power of the world. The practical importance of the æsthetic judgment is not so obvious. Indeed, the æsthetic sentiment, the power of the beautiful and the ugly to attract the attention, has always been something of a puzzle to psychologists; and it cannot be said that the puzzle has even yet been satisfactorily solved.

§ 88. **The Æsthetic Sentiments.** — Modern psychology has devoted more attention to the æsthetic sentiments than to the other three groups. This is partly due, no doubt, to the difficulty which they present to psychological analysis; the intellectual, ethical and religious sentiments are more matters of course. But it is also due, in part, to the fact that the æsthetic sentiments can be examined under experimental conditions and with comparatively simple materials.

It is customary to distinguish five æsthetic sentiments: those of beauty, ugliness, the sublime, the comic and the tragic. The two first are of a purely æsthetic character; the third may be either mixed or pure; the two last are never wholly æsthetic in nature.

1. Under the heading of 'beauty' and 'ugliness' there are five principal forms of the æsthetic judgment: the judgment of visual form (architecture, and line in the plastic

and graphic arts), colour scheme (colour in the plastic and graphic arts), rhythm (dancing, musical form), harmony (music) and melody (music). We need here speak only of the first, second and fourth of these (*cf.* §§ 47, 48).

(1) *Visual figures* present two aspects for æsthetic appreciation: articulation or division, and contour or outline.

The most pleasing division of a simple visual form was, originally, the symmetrical division. Symmetry is repetition with reversal: the two hands, two eyes, two halves of a circle, etc., are symmetrical. The proportion of parts, in a symmetrical figure, is accordingly that of equality, 1 : 1.

At a higher level of æsthetic development, the symmetrical division is replaced by what is known as the golden section: a division of the figure at a point so chosen that the dimensions of the whole are to those of the larger part as the dimensions of the larger part are to those of the smaller. The proportion of parts in a figure divided at the golden section is, approximately, 3 : 5.

Even to-day symmetry holds its own as a principle of æsthetic division. A great deal of decorative work (on walls, ceilings, porcelain, etc.) is of the symmetrical type. And we see traces of its influence in the duplication which is so common a feature of graphic composition. One poplar in a landscape looks ugly; two make the picture a 'good composition.' So with two cows in a meadow, two human figures on a sea-coast, etc.

Method. — Prepare long series of simple geometrical figures, — crosses, ovals, rectangles, etc., — varying the proportions little by little throughout the series. Lay them before the observer, and let him pick out the most pleasing. The first few chosen will be figures whose proportions are in the near neighbourhood of the golden section; the last will, in all probability, be symmetrical. All the rest will be indifferent or displeasing.

It must be remembered that the eye is subject to certain illusions: vertical distances, *e.g.*, are always overestimated (§ 50). Hence in deciding whether the subject has chosen a figure in accordance with the rule of the golden section, or of symmetry, the experimenter must make allowances for possible illusion. The subjective square is not objectively symmetrical; but it is chosen because of its subjective symmetry. The amount of illusion in a given case can easily be determined by a few preliminary experiments.

As regards contours, not much more can be said than that curved lines are, on the whole, more pleasing than straight lines. The meeting of two straight lines in a right angle seems to be particularly displeasing; the eyes 'feel' the jerk involved in the abrupt change of direction.

(2) Nature presents us with so many and so various *colour schemes*, and painting consists so largely of an imitation of nature, that it is impossible to formulate general principles of æsthetic grouping in the sphere of colour. Rules are laid down, in practice, for the guidance of the art-student, as they are for the student of musical composition. Thus we may mention the rule of gradation: sharp contrasts are to be avoided, — unless, of course, it is the purpose of the picture to bring them out, — by the use of intermediate shades; the juxtaposition of complementaries is especially undesirable. The principle of compensation requires that a penetrating colour be balanced by a less penetrating; a spot of vermilion must be compensated by a large area of dull bluish green, placed somewhere in the picture to 'relieve' the red. The principle of duplication also holds; a painting which contains a large mass of some particular colour is improved by the introduction of a smaller patch of the same colour in a different quarter; and so on. But although

these and similar rules are doubtless indicative of ultimate æsthetic principles, they do not take us very far towards an understanding of these latter.

Writers upon colour decoration, ornamentation, recognise two types of colour scheme: the dominant and the contrasted. The dominant scheme employs a single key-colour, and obtains an æsthetic effect by the arrangement of different 'shades' and 'tints' of this colour (mixtures of the pure with white light, at different intensities and in different proportions: § 12). Thus if red were chosen as the key-colour, the scheme would be composed of red, and of pinks and dark reds. The contrasted scheme employs two key-colours, and interweaves these with their shades and tints into an æsthetic whole.

Method.—The most pleasing juxtapositions and arrangements of colours could be investigated by the help of a long series of coloured papers. Strips must be cut, and pasted side by side on a constant background (black or white cardboard). It would probably be found that the subject, though very sure of what was positively ugly, would be in considerable doubt as to the comparative beauties of the 'pretty' combinations.

(3) The most pleasing musical *harmony* was, originally, that of the octave. As the æsthetic judgment developed, however, the place of the octave was taken by other, less unitary tone mixtures. To us the octave sounds 'thin' and 'poor'; the major third (the union of tonic and mediant of a major scale) is the harmony which brings with it the greatest amount of æsthetic pleasure. The octave, then, may be compared to the symmetrical division of a simple visual form, and the major third to its division at the golden section.

Method.—Experiments can be made with tuning-forks or piano clangs, as described in § 49. The subject is required to judge of the æsthetic effect of the chords and intervals sounded.

2. The sentiment of sublimity is more complex than that of beauty or ugliness. It contains two central judgments: 'This is beautiful' and 'This is great.' The total experience may be pleasant or unpleasant, according to the meaning of the second of these judgments. If 'great' means 'so great that my attention cannot grasp it,' the experience is unpleasant: the pleasure of beauty is overcome by the unpleasantness of the emotion of fear, or the sentiment of awe. If 'great' means 'splendid' or 'magnificent,' the whole experience is pleasurable; the sentiment of beauty is simply enhanced. Under these circumstances, the sublime is to the beautiful as a 'handsome' is to a 'pretty' face.

3. The sentiments of the ludicrous and the tragic are also complex. The latter combines the judgment 'This is beautiful' with the judgment 'This is undeserved'; there is a mixture of the æsthetic sentiment of beauty with the ethical sentiment of injustice. The total experience may be pleasant or unpleasant, according as the one or the other sentiment predominates.[1] — The pleasurable effect of a 'comic' situation is difficult to explain. The situation appears to call forth the judgments 'This is beautiful,' or rather 'This is pretty,' and 'This is contradictory.' There is a quick oscillation of the pleasure of the former and the unpleasantness of the latter judgment.

One is tempted to compare the sentiment of the ludicrous with the complex of organic sensations which we call tickling (§§ 19, 59). On its cutaneous side, tickling consists of light pressures

[1] It is, perhaps, hardly necessary to state that the scientific meaning of the terms 'tragedy' and 'tragic' differs from their popular meaning. The newspapers speak of a murder or a fire as a 'tragedy,' when as a matter of fact the situation described arouses the emotion of horror or disgust, not the tragic sentiment. (*Cf.* § 2.)

(pleasant) which are intermittent (unpleasant: § 34). As there are no such things as mixed feelings (§ 32), we must have in tickling, cutaneously regarded, an alternation of pleasantness and unpleasantness. A 'comic' situation would seem to give rise to just such an alternation, a sort of central tickling. It is 'pretty' (pleasant), but self-contradictory (logical sentiment of contradiction; unpleasant). Neither the pleasantness nor the unpleasantness is very intensive: if 'prettiness' rises to beauty, we are jarred by the contradictory element, and if the self-contradiction is too pronounced, no æsthetic sentiment is aroused at all. We may note that laughter is the natural expression of the comic sentiment, and that some psychologists derive all laughter from that which follows upon tickling (§ 59).

We indicated two modes of classifying the emotions (§ 58): they may be divided into two groups, as qualitative and temporal emotions, or emotions of subject and emotions of object. The æsthetic sentiments appear to be always qualitative in character. And they appear, also, to be always objective. If the sentiment of beauty is subjectified, we have not a sentiment but an emotion: the beautiful scene or object 'charms' or 'entrances' or 'intoxicates' us, takes possession of consciousness; the hideous object sets up the emotion of repugnance or disgust.

There is a possible exception to this rule in the dignity which is the subjective side of sublimity (sublimity in its second sense, as splendid beauty). Dignity would seem to be a sentiment rather than an emotion.

We may note that there are degrees of the æsthetic sentiment, as there are of emotion (§ 60). A landscape is pretty, beautiful or sublime; a face comely or handsome, plain, ugly or hideous; a situation funny, ludicrous or 'excruciatingly' funny.

§ 89. **The Basis of Æsthetic Sentiment.** — We said above that no completely satisfactory account of the origin of the

æsthetic sentiment, no adequate explanation of the power of the beautiful and the ugly to hold the attention, has as yet been given. We may now look briefly at some of the suggestions which have been made.

(1) It has been asserted that the five forms of the æsthetic sentiment proper can all be traced to peculiarities of human structure or function. Thus the human figure is symmetrically built; hand repeats hand, and foot, foot. Moreover, waist repeats neck, abdomen repeats chest, legs repeat arms. The proportions of the body, measured from the navel as centre, are approximately those of the golden section. Moreover, the upper part is divided at the neck, and the lower at the knees, roughly in the same ratio, 3 : 5. Rhythm, again, is given in walking and breathing; melody, in the natural rise and fall of the voice (§§ 47, 50). Inharmonic combinations of tones produce beats, jarring intermittences of sound, which are intrinsically unpleasant (§ 34). Lastly, the appreciation of colour schemes may have its basis partly in the existence of complementary or contrasting colours (§ 12), partly in the characteristic colour patterns of animals lower in the scale of organic development than ourselves.

(2) Many writers upon æsthetic questions postulate a general principle of beauty,—the principle of 'unity in multiplicity.' The beautiful impression is that which is at the same time one and more than one. A colour scheme or a melody is a single whole; yet it is an articulated whole, a whole whose division is as noticeable as its singleness. The primitive æsthetic judgment is unable to cope with any but the most simple articulation: symmetry and the octave are therefore found beautiful at a time when the major third would be dissonant, and division at the golden

section a division which forbade any appreciation of the unity of the divided figure. 'Wholeness' and 'unity' consist, psychologically, in the capacity of the total process for reproduction and association as a single idea (§ 51).

(3) It has recently been suggested that the æsthetic sentiments are the counterparts of the emotions of sympathy and antipathy. We have already (p. 315) noted the fact that primitive man anthropomorphises his physical surroundings. Originally, the theory says, that is beautiful to man which he regards as reflecting his own pleasurable emotion, which he judges to be in sympathy with him. The beautiful woman is the woman who shows pleasure in the man's adornment or prowess; the beautiful landscape is the 'smiling' landscape; the beautiful hut or temple is the one which reflects the builder's own self-satisfaction; and so on. The æsthetic sentiments are one's own emotions, projected into other people or into external nature, and refound there by one's active attention. The 'projection' is merely an effect of the general anthropomorphising attitude of the primitive mind.

There may be truth in all three of these views. (1) The first explanation, however, is evidently imperfect, and (when it speaks of the proportions of the human figure) fanciful and even inaccurate. Let us grant that the arrangements and activities of the form peculiar to one's own species will naturally be pleasing. Still, there seems to be no adequate reason in this fact for the progress and scope of æsthetics, for the extreme attention devoted to æsthetic influences by civilised peoples. (2) Again, there can be but little doubt that associability, effectiveness for reproduction, is one of the conditions of the appearance of the æsthetic sentiments. But we can hardly grant that it is the sole condition. And the theory is rather logical in its statement than psychologi-

cal; a reflection upon the facts, rather than a formula embracing them (§ 86). (3) The third hypothesis is plausible; but it is, so far, simply a suggestion, and has not been worked out in the necessary detail. If we accept it, provisionally, we have the advantage of possessing a sanction for æsthetics, *i.e.*, a reason for the persistence and growth, as well as for the emergence, of the æsthetic sentiment. Æsthetics would first come into play in courtship (dress, bodily adornment) and in religious ceremonial (temple decoration, ritual): two very important matters. Later on, in civilised communities, it would obtain a further value as the recreation of educated people. Moreover, we can 'reconcile' this view with the other two. The first explanation given above would simply furnish certain details of æsthetic theory, give the 'why' of this and that particular feature of the æsthetic reaction; and the second would name one of the salient characteristics of the æsthetic consciousness,— its richness in reproductive ideas. But suspense of judgment is, for the present, the wisest choice.

§ 90. **The Intellectual Sentiments.**—The intellectual or logical sentiments are the affective experiences which cluster round judgments of truth or falsehood. The situation which evokes the judgment is, in this case, not a concurrence of processes in the outside world, but a concurrence of associations in consciousness; thought itself, a mental situation, is disjoined by the attention for reassociation. We have, therefore, in the intellectual sentiments another instance of that 'projection outwards' or 'objectification' which we have seen to be illustrated by the formation of the ideas of affection (§ 59) and of self (§ 81), and, possibly, by that of the æsthetic sentiments.

The intellectual sentiments can be classified, in part, upon the same principles as the emotions (§ 58). (1) They fall into two great groups as qualitative and temporal. Thus curiosity (§ 1) is an instance of temporal sentiment,

which may become qualitative in the form of successful thought (curiosity fulfilled), unsuccessful thought (curiosity unfulfilled) or baffled thought (curiosity deferred).

(2) The intellectual sentiments fall also into two great groups as objective and subjective sentiments. Each occurs in a more objective and a more subjective form. Thus we have:

OBJECTIVE SENTIMENTS		SUBJECTIVE SENTIMENTS	
Objective	Agreement.	*Objective*	Truth.
	Contradiction.		Falsehood.
Subjective	Ease.	*Subjective*	Belief.
	Difficulty.		Disbelief.

(3) There are, however, certain sentiments which have no emotive counterparts. These are the oscillatory sentiments, which accompany a rapid alternation of the attention between the two possible predicates of the judgment. Thus midway between the sentiments of agreement and contradiction lies the oscillatory sentiment of obscurity; between ease and difficulty of thought lies confusion; between truth and falsehood, ambiguity; and between belief and disbelief, doubt. This form of experience is, of course, impossible in cases where only the passive attention is exercised, *i.e.*, in the emotion: oscillation between pleasantness and unpleasantness can take place only when the active attention is present to oscillate.

Each one of these sentiments has a corresponding mood. Thus the mood of belief is acquiescence; that of disbelief, incredulity; that of doubt, indecision. And each one of them may, in course of time, lose its affective tone, and give place to a state of indifference.

Method. — The intellectual sentiments might be investigated in the following way. Prepare a number of reasoned statements, —

or select them from the lists given in the text-books of formal logic, — some of which are correct, while others contain various logical fallacies. Let the subject give a careful introspective account of the 'feelings' aroused by their reading. — It is possible that a systematic employment of this method would enable us to distinguish a greater number of special intellectual sentiments than have hitherto been described.

A rough notion of the number and forms of the intellectual sentiments can be obtained by introspection of consciousness during the reading of a piece of scientific reasoning, or the hearing of a scientific lecture. The array of arguments as 'first,' 'secondly,' 'thirdly,' etc., arouses the mood of acquiescence; an emphatic 'if,' the sentiment of doubt; a 'but,' the sentiment of contradiction; a "*Now*, then, we can see . . ." the sentiment of truth; etc.

Literature. — Literature, prose and poetry is, perhaps, the form of art which gives rise to the most complex sentiments. We have in reading it (1) the æsthetic sentiments of rhythm and musical harmony; (2) the intellectual sentiments of agreement and truth; (3) oftentimes an ethical or religious sentiment, attaching to the contents of the passage read; and (4) oftentimes a secondary æsthetic sentiment, accompanying the reproductive ideas which supplement the printed words in our minds. We can understand this many-sided effect of literature when we remember the large part played by verbal ideas in every type of consciousness.

§ 91. **The Social or Ethical and the Religious Sentiments.** — The situation which arouses an ethical sentiment is any action or group of actions, performed by oneself or another, of which the term 'good,' 'bad,' 'right' or 'wrong' may be predicated.

It is plain that we have two great classes of these sentiments: the subjective, attaching to judgment of our own action, and the objective, attaching to judgment of the

action of others. Among the subjective may be counted shame and pride, humiliation and vanity, guilt and innocence, freedom and restraint, etc. Among the objective are trust and distrust, gratitude and ingratitude, envy and compassion, jealousy and magnanimity, emulation and self-effacement, indebtedness and patronage, forgiveness and revenge, etc. It is plain, too, that some of these sentiments occur in a more subjective and a more objective form: thus praise and blame are the objective correlates of pride and shame, justice and injustice the objective correlates of innocence and guilt, security and insecurity the subjective correlates of trust and distrust, honour the subjective correlate of duty. But it is impossible to make out a complete list, or to set up a satisfactory classification, of the ethical sentiments. The situation judged is, as a rule, so important to us, so absorbing, that the sentiment passes over into an emotion; guilt and innocence become hope and fear, envy and compassion are lost in hate and affection ("pity's akin to love"), humiliation changes to chagrin, etc.

Although they spring from a different root, and although the judgments to which they attach are intrinsically different, the religious sentiments are, in the civilised society of to-day, most intimately connected with the ethical. Many of the experiences mentioned in the previous paragraph may be grouped round the religious judgment. Further to mention are the sentiments of awe and reverence, humility and unworthiness, faith and resignation, exaltation and remorse, etc. All of these sentiments readily pass into emotions.

Method. — The ethical and religious sentiments could be investigated, perhaps, by help of the *questionnaire*. The *questionnaire*

is a series of questions, submitted to a large number of persons for introspective answer; it is a device to secure the advantages of comparative introspection (§ 9; *cf.* § 35).

In the present case, a number of typical instances of conduct would need to be collected. The list would be headed by the direction: 'Read these cases, one by one, and decribe introspectively the feelings which they arouse in you.' If the persons appealed to were well versed in the employment of psychological method, their replies might go far to bring order into the existing chaos.

The *expression* of the sentiments, so far as it has been investigated, does not differ in kind from that of the emotions. Thus if the subject, placed as described in § 33 (2), be shown a prettily painted decorative pattern, pulse and breathing are heightened, and volume and muscular strength increased.

Language furnishes many illustrations of the connection of sentiment and emotion, and of the community of organic sensations in the formation of both. 'Anger,' as we saw on p. 231, means a choking or strangling. Philologists tell us that 'awe' and 'ugly' — words denoting a religious and an æsthetic sentiment — are from the same root as 'anger.'

References for Further Reading

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CHAPTER XIV

THE SYNTHESIS OF ACTION. THE REACTION EXPERIMENT

§ 92. **The Synthesis of Action.** — In Chapter X we analysed and classified the various forms of action, but did not attempt an experimental reconstruction of the action-consciousness. We have now to make good this omission; to put together the processes which we found to be involved in action, and to show by synthesis that our analysis was correct.

The method which enables us to effect the synthesis of action, to put together, for experimental purposes, the constituents of which the action-consciousness is composed, is known as the *reaction method.* A reaction is an artificial action. It is agreed between two persons, the 'experimenter' and the 'reactor,' that on the occurrence of a certain sensory stimulus (given by the experimenter) a certain movement shall be made (by the reactor). The sensation set up by the stimulus corresponds to the object-idea in impulsive, etc., action; the simple movement made in response to it corresponds to the complicated movements of crouching down, clenching the fist, etc. We may make the reaction impulsive, volitional, etc., as we please, by prearranging the conditions under which the experiment is performed.

The reaction experiment consists, on its objective side, in the accurate measurement of the time elapsing between

the occurrence of the sensory stimulus and the execution of the movement in response to it; on its subjective side, in the introspective examination of the conscious processes which run their course during this time, and for some 2 sec. before it. The responsive movement may follow at once upon the sensing of the stimulus, or may be restrained until certain connections have been formed in consciousness. In the former case we speak of a *simple*, in the latter of a *compound* reaction.

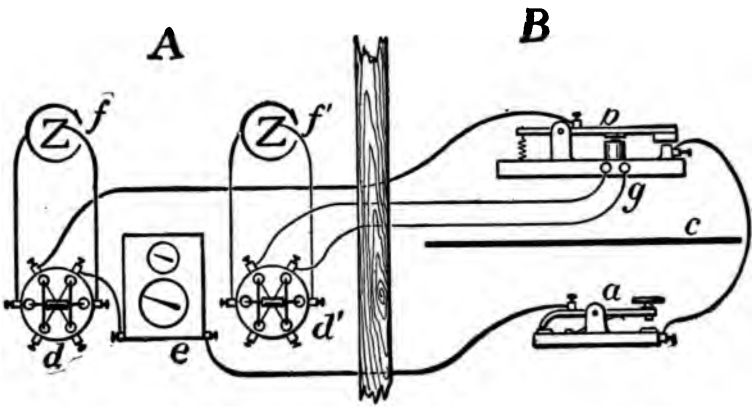

FIG. 10.

Method. — Figure 10 shows one of the sets of apparatus most commonly employed in the reaction experiment. *A* and *B* are different rooms: the reactor sits in the reacting room, *B*, the experimenter, who notes the time taken by the reaction, in the registration room, *A*. Reactor and experimenter are separated in order that the reactor's introspection may be undisturbed by noise, etc.

a is a telegraph key. The reaction movement employed with this set of instruments consists in the lifting of the first or second finger of the right hand from the button of the key. *b* is a steel hammer (§ 29), the head of which can be lowered so as to

strike upon a steel block placed beneath it. The sound made by the fall of the hammer is the stimulus to which the subject in the present experiments is to react. *c* is a screen, which prevents the reactor from seeing the hammer fall, and consequently moving his finger too soon (reacting to sight, instead of to sound).

Hammer and key are connected with an electric clock, or chronoscope, *e*. The clock has two dials. A complete revolution of the hand of the lower dial occupies 10 sec., a complete revolution of that of the upper dial, $\frac{1}{10}$ sec. The circumference of each dial is divided into 100 parts; so that the unit of measurement on the lower dial is $\frac{1}{10}$ sec., that on the upper, $\frac{1}{1000}$ sec. To read the time from the clock, therefore, we have only to add the figures of the upper to those of the lower dial; if the lower hand points to 76, and the upper to 25, the time is 7.625 sec. The chronoscope (in this arrangement of the apparatus) goes only when the electric current is passed through a magnet, which is attached to the clockwork.

The wires which connect together hammer, key and chronoscope run to the battery *f*, by way of a commutating key, *d*. The function of this key is to change the direction of the current sent through the chronoscope in successive experiments. In one experiment, the current takes the direction +‾+]⌣[‾−; in the next, the direction +‾X+‾−. This reversal is necessary, since a current which travelled always in the same direction would permanently magnetise the chronoscope magnet, and so alter the times recorded by the dials.

Below the shaft of the hammer *b* is placed an electromagnet, *g*, wires from which run to the battery *f'*, by way of the commutator *d'*. Closure of the commutator sends a current through the magnet, and the head of the hammer is thus pulled down upon the steel block.

We will suppose now that an experiment is to be made. The experimenter, seated before the chronoscope in the registration room, closes the commutator *d*. Having done this, he signals to the reactor (by means of an ordinary electric bell, not represented in the Figure) to prepare for the reaction movement. The reactor

lays his right arm on the table which carries the reacting key, *a*, and rests the first or second finger of the right hand upon the button, thus closing the key. We have (1) *a* closed, *d* closed, and *b* open. Two seconds after his signal (§ 41), the experimenter closes the commutator *d'*; the hammer falls. The sound stimulus is thus given, while we have (2) *a* closed, *d* closed, and *b* closed: the chronoscope hands begin to move. The reactor, hearing the hammer fall, raises his finger from the button of *a*,—*i.e.*, 'reacts.' We have (3) *a* open, *b* closed, and *d* closed: the chronoscope stops with the breaking of the circuit at *a*. If the hands pointed to 7.625 at (2), and the dials now read 7.819 at (3), we know that the whole time, from the dropping of the hammer to the moving of the finger, was .194 sec. This interval is called the 'reaction time'; and its unit, the thousandth of 1 sec., is called a 'sigma' (Greek σ).

While the experimenter is reading the reaction time from the dials of the chronoscope, the reactor writes out an introspective account of his reaction-consciousness, beginning from the sounding of the signal bell, 2 sec. before the hammer fell, and ending with the snapping of the finger from the button of the reacting key. Presently the signal is again sounded by the experimenter, and a new experiment begins. It is customary to limit a series of experiments to 15 or 20, since the strain of attention necessary for reacting and for the subsequent introspection is very great, and the reactor soon becomes fatigued (§ 10).

The psychological laboratories contain many forms of the reacting key, many kinds of instruments whose function it is to give the stimulus which starts the reaction experiment, and many apparatus for time registration. The responsive movement need not be made with the finger; it may be performed by lips, eyelid, vocal organs, tongue, foot, etc. And the stimulus need not be auditory; it may be visual, tactual, etc. Moreover, the movement may be movement not of a single finger, but of different fingers in different experiments: in such cases a five-finger key is employed. And the impression may not be known beforehand to the reactor; it may be one of a number of colours, sounds, etc.: in such case the apparatus which gives the stimulus becomes very complex.

The reaction time in the instance given above is the time elapsing between the fall of the hammer and the movement of the finger from the key. Within this time, the external stimulation has made its way through the ear, and the excitation set up in the hair-cells of the basilar membrane has travelled to the brain. Moreover, the outgoing excitation has run down the right arm, to the finger-tip. No one of these physiological processes is accompanied by a conscious process. Plainly, then, the reaction time is the duration of more than a simple action-consciousness: it is the duration of this, *plus* the duration of certain physiological processes. It is, unfortunately, impossible to measure the physiological processes by themselves, and subtract the time which they require from the total reaction time; so that every recorded reaction time is somewhat too long. This fact, while it does away with the absolute value of the figures read from the chronoscope, does not lessen their relative value. If a reaction time which includes, say, the formation of an association of ideas is longer than a reaction time which does not, the difference may be referred, other conditions being equal, to the association.

§ 93. **The Simple Reaction.** — In the simple reaction experiment, the movement follows at once upon the sensing of the stimulus. In other words, the simple reaction is an artificial impulsive action. But the impulsive action of real life passes over into reflex action; and in like manner the simple reaction, by a fitting preadjustment of its conditions, may be brought very near to the reflex type. We thus have two forms of simple reaction: the true or impulsive form, or, as it is usually termed, the 'sensorial' reaction; and the curtailed or reflex-like form, usually termed the 'muscular' reaction.

(1) *The Sensorial Reaction.* — In the sensorial reaction experiment, the reactor is directed to hold his attention from the outset upon the sensory stimulus, and to withhold the reaction movement until he has sensed that stimulus.

At the beginning of the experiment, therefore, consciousness is dominated by an idea of end, and by a centrally aroused sensation (or verbal idea) which corresponds to the expected stimulus. When the stimulus is given, this centrally aroused object-idea is replaced by the peripherally aroused sensation, which brings with it the recognitive mood or mood of direct apprehension. We now have two of the three factors in the impulse: the ideas of object and of end. These are immediately supplemented by the idea of movement, and the motor response to the stimulus is made.

The stages in the formation of the reaction-consciousness (sensorial reaction) may, therefore, be tabulated as follows:

(1) idea of end *plus* anticipation of object;
(2) idea of end *plus* idea of object, with mood of 'at home' or 'of course';
(3) idea of end *plus* idea of object *plus* idea of movement;
(4) sensations set up by movement.

The idea of end soon ceases to play any considerable part in the reaction-consciousness. At first it may be vividly present, as the idea of gaining control over the attention, getting practice in introspection, adding to the sum of psychological facts, doing a piece of prescribed work well, etc. But with frequent repetition of the experiments, it loses its original definiteness, until, in course of time, all that is left of it is the mood of direct apprehension set up by the sight of the reaction table, screen, etc.

The duration of the simple sensorial reaction differs according to the sense department from which the object-idea is taken, *i.e.*, to which the stimulus appeals. This time difference is, in all probability, due to the physiological conditions of stimulation of the different sense-organs, and accordingly has no psychological significance.

The sensorial reaction time has been determined in the spheres of sight, sound, pressure, taste, smell and temperature. But the

conditions of stimulation in the three last cases are so variable and so little understood that the time measurements are of small psychological value. For purposes of introspective analysis and comparison, therefore, we must confine ourselves to reactions in the domain of sight, sound and pressure.

The average durations are as follows:

(1) Sensorial reaction to light: 270σ;
(2) Sensorial reaction to sound: 225σ;
(3) Sensorial reaction to pressure: 210σ.

(2) *The Muscular Reaction.*—In the muscular reaction experiment, the reactor is directed to hold his attention from the outset upon the movement which is to be made in response to the stimulus. At the beginning of the experiment, therefore, consciousness is dominated by the ideas of end and of movement. When the stimulus is given, and the object-idea added to these two ideas, the impulse is complete: motor response to the stimulus is immediately made.

The sensorial reaction can never pass over into a reflex action, since, by the conditions of the experiment, movement cannot take place until the ideas of end and of object have been supplemented by the idea of movement. The muscular reaction, on the other hand, may, in course of practice, come very near to the reflex type. In the first place, the idea of end tends to disappear, as the reactor grows accustomed to the experiment. In the second place, the concentration of attention upon the movement to be made paves the way for the actual movement; the attention does for this movement what biological conditions have done for other movements which are of the true reflex order; there exists, for the time being, a sort of 'reflex arc' (§ 66) between the sense-organ to

which the stimulus appeals and the muscles concerned in the reaction movement, — just as there exists a permanent reflex arc between, *e.g.*, the pressure organs in the cornea of the eye and the muscles concerned in winking. Hence it is intelligible that the muscular reaction should be quick and spasmodic, and that it should oftentimes seem, when introspectively examined, to have taken place automatically, reflexly, without the intervention of any object-idea at all.

When the reactor is new to the reaction experiment, the stages in the formation of the reaction-consciousness (muscular reaction) may be tabulated as follows:

(1) idea of end *plus* idea of movement;
(2) idea of end *plus* idea of movement *plus* idea of object;
(3) sensations set up by movement.

But in its most reflex-like form, as performed by a highly practised subject, the reaction is accompanied only by the following processes:

(1) idea of movement;
(2) sensations set up by movement.

The idea of end lapses altogether, and the object-idea comes to consciousness later, after the movement has been made.

The average durations of the muscular reaction are as follows:

(1) Muscular reaction to light: 180σ;
(2) Muscular reaction to sound: 120σ;
(3) Muscular reaction to pressure: 110σ.

These times are too long to be *pure* reflex times: the winking reflex occupies only about 50σ. But they are reflex-like. This is borne out not only by the verdict of introspection, but also by the fact that the muscular reaction is not infrequently made too soon, or made in response to the wrong stimulus. If the attention has done its work thoroughly, and the 'reflex arc' is well connected in all its parts, there is a constant tendency for the move-

ment to 'go off'; any slight provocation, such as the creaking of a chair in the reacting room, is enough to bring about the jerk of the finger from the key.

The difference between the average sensorial and the average muscular reaction time amounts, as the tables show, to about 100σ or $\frac{1}{10}$ sec. The difference is so constant that the experimenter, as he reads the figures from the chronoscope, can tell whether the subject is reacting in the one way or the other. This objective control is most valuable, since it enables us to educate the reactor in introspection, to aid him in gaining subjective control of his action by acquiring a mastery over the attention (§ 97).

The Mean Variation. — If we are to estimate the introspective power of the reactor, we must know not only the average duration of his sensorial and muscular reactions, but the regularity or irregularity with which he reacts. Thus suppose that in three successive sensorial reactions to sound the chronoscope read 110σ, 320σ and 245σ. The average of these three times is a good average: 225σ. But the irregularity is so great that the reactor could not be credited with any considerable degree of control over his attention.

Hence it is usual to record not only the average reaction time of each reactor, but the mean variation of that time. By the 'mean variation' we mean the average difference between the average reaction time and the single reaction times gained in the course of an experimental series. Thus 110σ differs from the average time (225σ) by 115σ; 320σ differs from it by 95σ; and 245σ differs from it by 20σ. The mean variation in this case is $(115 + 95 + 20) \div 3$ (the number of experiments in the series); *i.e.*, 77σ.

The mean variation of a practised reactor is 10σ for muscular reactions, and about 25σ for sensorial.

The simple reaction experiment can be varied in many ways. Thus we can investigate the influence of the intensity of stimulus, of variation of the time allowed for preparation of the attention,

of the omission of the signal, of the occurrence of distracting stimuli, etc. The results of such experiments are all valuable as throwing light upon the working of the attention.

§ 94. **The Discrimination Reaction and the Cognition Reaction.** — In its sensorial form, the simple reaction is an artificial impulsive action. In the experience of everyday life, we have conflicts of impulses with one another, the result of which may be inaction or selective action, and conflicts of impulses with other groups of associated ideas, the result of which may be inaction or volitional action. Now if we can introduce these conflicts into the course of the reaction experiment, we shall be able objectively to measure and subjectively to examine the two most complicated forms of the action-consciousness.

It is possible, by the help of the reaction method, to put together an artificial selective or volitional action. But the end cannot be reached by a single step. We must advance to 'choice reactions,' as they are termed, by way of the 'discrimination reaction' and the 'cognition reaction.'

(1) *The Discrimination Reaction.* — The discrimination reaction differs only in one respect from the simple sensorial reaction. In the latter, the subject reacts to a single known stimulus; in the former, to one of two or more known stimuli. The reactor is told, *e.g.*, that he will be shown either black or white, and that he is to react when he has cognised the black as black or the white as white; but he does not know which of the two brightness qualities to expect in each particular experiment. He has to 'discriminate' the stimulus which is actually employed.

(2) *The Cognition Reaction.* — The cognition reaction differs in two respects from the simple sensorial reaction.

In the first place, the subject is required to react only when he has cognised some one of two or more possible stimuli; the cognition reaction is a discrimination reaction. In the second place, the reactor does not know, except in a quite general way, what stimulus he is to expect. Thus he may be told that he will be shown a light stimulus, and that he is to react when he has cognised this stimulus as a particular brightness or a particular colour; but nothing more explicit is said.

If we wish briefly to characterise these three forms of reaction, we may say that (1) the simple sensorial reaction involves cognition of one known stimulus, (2) the discrimination reaction involves cognition of some one of a number of known stimuli, and (3) the cognition reaction involves cognition of some one of a number of unknown stimuli,—'unknown,' that is, so far as ignorance is permitted by the conditions of the method at large.

The reader must remember that the titles 'discrimination reaction' and 'cognition reaction' are employed in narrow and special senses. The 'discrimination reaction' implies a cognition; and the 'cognition reaction' implies a more elaborate discrimination than does the 'discrimination reaction' technically so called.

Both the discrimination reaction and the cognition reaction are longer than the simple sensorial reaction. The time differences between the latter and certain forms of the cognition reaction are given in the following table:

The 'cognition' of a colour requires	30σ;
The 'cognition' of a printed letter requires	50σ;
The 'cognition' of a short word requires	50σ.

With simple stimuli, of this kind, there is hardly any difference between the durations of the discrimination and cognition reaction. The rule seems to be, however, that discrimination requires a slightly shorter time than cognition.

§ 95. **The Choice Reaction.** — The choice reaction is an artificial selective or volitional action.

(1) *The Choice Reaction as Selective Action.* — This reaction, in its simplest form, is a direct development from the discrimination reaction. The reactor is told, *e.g.*, that he will be shown either black or white, and that he is to react only when he has cognised the black as black or the white as white. So far, the directions are the same as those for the discrimination reaction. But further, he is to react to black by a movement of the right hand, and to white by a movement of the left hand. This additional direction introduces a conflict of impulses into the course of the experiment.

(2) *The Choice Reaction as Volitional Action.* — This reaction also is built up, in the first place, from the discrimination reaction. The reactor is instructed as before, except that he is told to react to black by a movement of the right hand, and not to react to white at all. There is thus introduced into the experiment a conflict between an impulse and another group of ideas.

Both forms of the choice reaction, however, may be based upon the cognition reaction, instead of the simpler discrimination reaction. Thus the reactor may be told that he will be shown a colour or a letter, and that he is to react by naming the impression, *i.e.*, by a movement of the vocal organs. He is here left in entire ignorance as to what colours or what letters will be exposed. The reaction will, in this case, be an artificial selective action. Or he may be told that he will be shown either a colour or a letter, and that he is to react to the former by naming the given impression, but not to react to letters at all. In this case, the reaction would be an artificial volitional action.

(1) It is plain that the time occupied by the conflict of impulses in the first form of the choice reaction will depend very largely upon the reactor's practice, and upon the number of impressions used. If no more than two stimuli are employed, — say, black and white, — the connection of black with right-hand movement and of white with left-hand movement may become so stable, in course of practice, that there is really no conflict of impulses in the case. The reaction may come to be as much a matter of course as the taking of a knife in one's right hand and a fork in one's left (§ 96). On the other hand, if ten colours are used, and the reactor instructed to reply to each colour by the movement of a particular finger, there will nearly always be some conflict of impulses, hovever great the amount of practice.

The following may be taken as instances of the duration of the choice reaction[1] (selective action). (*a*) Nine persons were required to react to two intensities of sound by movements of the two hands. The average time of the choice reaction was 316 σ. When we remember that the simple sensorial reaction to sound occupies 225 σ, and that the remaining 91 σ represents not only the 'choice,' *i.e.*, the conflict of impulses, but also the 'discrimination,' *i.e.*, the cognition of the loud as 'the loud' and the weak as 'the weak' sound, we see that the conflict of impulses in the experiments was not very serious. 'Choice' could not have occupied more than 60 σ.

(*b*) In another investigation, ten persons reacted to ten impressions (the figures 1, 2, 3, 4, 5, I, II, III, IV and V) by movements of the fingers of the two hands. The average time of reaction was 610 σ. If we subtract from this total 270 σ for the simple sensorial reaction time, we have a remainder of 340 σ. Allowing

[1] The figures given here and later in the chapter must be regarded as quite rough averages. The duration of a compound reaction varies so greatly with variation of the experimental conditions, and conditions have varied so greatly in the investigations as yet carried out, that it is very difficult to make any general statement as to the time occupied by the processes of 'choice' and association.

30–50 σ for 'discrimination,' we have 290–310 σ as the time occupied by the conflict of impulses.

(*c*) We now come to the consideration of choice reactions which presuppose not the 'discrimination' reaction but the 'cognition' reaction. Two persons reacted to colours, letters and short words: the reaction movement consisted in the articulation of the name of the given impression. The average times were: for colours, 550 σ; for letters, 410 σ; for short words, 390 σ. From the first we must subtract $270 + 30\sigma$: the time occupied by the conflict of impulses was, therefore, 250 σ. From the second and third we must take $270 + 50\sigma$: the times occupied by the conflict of impulses were 90 and 70 σ.

(2) It seems that volitional action is, on the whole, somewhat shorter than selective. The nine persons who gave an average selective reaction of 316 σ in the experiments with two intensities of sound, described above, gave an average reaction of 310.5 σ when required to react with the right hand to the weaker sound, and not to react to the stronger at all. This time difference is so small as to be for all practical purposes no difference. Other experiments, however, seem to show that the rule is as stated.

§ 96. **The Automatic Reaction.** — Impulsive action becomes reflex: we have not only the sensorial but also the muscular form of the simple reaction. In the same way, selective and voluntary action, if constantly repeated, become automatic: we have automatic reactions in addition to choice reactions.

The automatic reaction is psychologically valuable as a supplement to the muscular simple reaction. This latter, it will be remembered, is from the outset an artificial reflex; we prearrange the conditions of the experiment with the intention of getting a reaction which shall be as near a reflex action as possible. The muscular reaction is not a degenerated sensorial reaction. On the other hand, the automatic reaction is a degenerated choice reac-

tion; it is a secondary reflex, derived directly from an artificial selective or volitional action.

If, then, we continue a choice reaction until it becomes automatic, we gain opportunity to observe introspectively the emergence of a secondary reflex. The experimentation is further valuable as illustrating the course of practice.

In cases of extreme automatism, the discrimination of two known colours has been found to require only 11σ; that of the locality of a sound, only 15σ.

The tendency of the reactor towards automatism is one of the greatest difficulties which the investigator of compound reactions has to encounter. He must secure thoroughly practised subjects, and yet take care that their practice does not go too far.

§ 97. **The Function of the Reaction Experiment.** — The reaction, as we have described it in preceding Sections, is an artificial, schematic, simplified action, — an action which may be impulsive, selective, volitional or approximately reflex, as the experimenter desires.

For psychological purposes, this artificial action presents many advantages over the action of real life. In the first place, it is action reduced to its lowest terms. The stimulus which starts it, and the movement with which it ends, are both exceedingly simple. In the second place, it is pure action, action unmixed with any other complex conscious experience. It follows from these two facts that, under the conditions of the reaction experiment, the subject can introspect the action-consciousness in a way which is altogether impossible under ordinary circumstances. Thirdly, the reaction is action, the precise duration of which is recorded. This fact also is an aid to introspection. Not only, that is, has the reactor the

means of complete introspective control of his action: the experimenter, who notes the time which the reaction takes, can assist him by the information that the times are different in this and the other case, and that therefore the processes constituting the action-consciousness in those cases must have been different.

This, then, is what we may call the intrinsic function of the reaction experiment, — to bring together the processes which make up the action-consciousness, under conditions which are as favourable as possible to their introspection. Incidentally, however, the reaction method has been turned to account in various ways for the illustration of other psychological facts or laws. Thus it has been found that the 'cognition' of intensities requires a longer time than the 'cognition' of qualities of sensation. This is in entire agreement with a conclusion at which we arrived on other grounds, — the conclusion that the quality of a sensation is its 'absolute' attribute, while the other attributes are only relative or comparative (§ 26). The reaction method has also been employed to compare different clangs with respect to their unitariness or singleness of effect. It is found that we cognise a minor third (*c*–♭*e*) more quickly than we cognise the corresponding major third (*c*–*e*). The minor third, that is, is less single, less unitary, a less complete 'fusion' than the major (§ 49). Again, the reaction method allows us to follow with great accuracy the course of expectation, practice and fatigue, — processes which, as we have seen (§§ 10, etc.), are of extreme importance, owing to their marked influence upon introspection in general.

We have a good illustration of this 'incidental' value of the reaction experiment in the figures quoted above, § 95 (1) (*c*)

The naming of an unknown colour required 250σ; the naming of an unknown letter or short word, no more than 90 and 70σ respectively. The reactors in these experiments stated that it was easier to name letters and words than colours, and especially such equivocal colours as rose, brown and violet. A statement of this kind, borne out as it is by the chronoscope figures, throws light upon what we may call the mechanism of mind.

This fact, that it is easier to name a word than a colour, may seem to conflict with the fact, previously noticed (§ 94), that it is easier to cognise a colour than a word. There is no contradiction, however. It is easy to cognise a colour because the colour stimulus presents a uniform surface, and asks but little of the active attention. The word-stimulus, on the other hand, is composed of letters, which may be very much alike, and which are both small and discontinuous. It therefore puts a greater strain upon the visual attention of the reactor.

There is, finally, one complex mental process for the investigation of which the reaction experiment is especially valuable. This is the successive association of ideas. The method of reaction has proved so useful in the study of the successive association, that psychologists have distinguished a special type of compound reaction, the 'association reaction.' We will devote a Section to its consideration.

§ 98. **The Association Reaction.** — In this experiment, the reactor is told that he will be shown a letter, colour, etc., and that he is to withhold the reaction movement until some one, two, etc., ideas have arisen in his mind at the suggestion of the stimulus. The association reaction, that is, is an extension of the cognition reaction: the stimulus, which is unknown to the reactor at the beginning of the experiment, must be cognised, and then succeeded in consciousness by another, centrally aroused idea.

The successive association introduced into the course of the reaction experiment may be (1) an association of the kind occurring in the train of ideas, or (2) an association after disjunction.

(1) The first type of association presents three typical forms. We may leave the reactor entirely free, directing him to wait until the stimulus has suggested some idea, but not limiting the association in any way. He has to 'think of something' before he reacts; but nothing is said as to what the thought must be. An association of this sort is termed a 'free' association. Secondly, we may restrict the range of association somewhat, telling the reactor that he is to think of something which stands to the stimulus as part to whole, as attribute, as instance, etc. Thus if the stimulus were the word 'chair,' the idea suggested might be chair-seat or chair-leg (part to whole), comfortable (attribute), the reaction chair (instance), etc. An association of this sort is termed a 'partially constrained' association. Thirdly, the association may be altogether 'constrained.' We may tell the reactor that he is to name the given stimulus, if it be a colour; to translate it into another language, if it be a word, etc. In such cases there is no choice; the association is constrained to follow one special line.

When we put a question to which there is an unlimited number of answers, the answer actually given is a 'free' association. When we put a question which admits of several answers, but not of an unlimited number, the answer given is a partially constrained association. When we ask a question to which only a single answer can be returned, we get a constrained association. Questions of these three kinds are asked, as it were, by the stimuli in the association experiment.

(*a*) *Free Associations.* — The average time of reaction which includes these associations, in cases where the stimulus used is a short word, is 1 sec. We must subtract from this total time 270σ for the simple sensorial reaction, and 50σ for the 'cognition' of the stimulus. This leaves us with 680σ as the time taken by the association alone.

(*b*) *Partially constrained Associations.*—The duration of this type of association varies very greatly, according to the nature of the stimulus and the character of the directions given to the reactor. Thus if the word 'chair' is shown, and the reactor required to think of some part of it, the range of possible associations is very limited: a chair has at most only back, legs, arms, seat, rockers, bars and cushion. In such experiments the whole association reaction does not require more than from 650 to 850 σ, *i.e.*, the association itself takes place in 330–530 σ. If the stimulus word had been less familiar, and the range of possible association similarly limited, the time would have been much greater. Suppose, *e.g.*, that the word 'pen' is shown, and the reactor required to think of a particular kind of pen. He is probably familiar with half-a-dozen different varieties; but if he has not given much attention to them, it may take him a relatively long time to call any special sort to mind.

If, on the other hand, the word 'white' is shown, and the reactor required to think of some substantive to which the adjective is applicable, the range of possible associations is very large. In such cases, there is very little difference between the duration of the partially constrained and of the free association.

(*c*) *Constrained Associations.*—A constrained association, like the more restricted type of partially constrained associations, may require a very short or a very long time, according to the nature of the stimulus. Suppose, *e.g.*, that names of countries are being shown, and the reactor is associating their capital towns to them. The capital of France would come to consciousness almost automatically (§ 96), in perhaps 300 σ; the word 'Paris' is one of the supplementary ideas which we ordinarily associate simultaneously to the word 'France.' But it might take us a full 700 σ to think of the capital of Siam or of Corea.

(2) The second type of association, association after disjunction, can be introduced into the course of the reaction experiment only in its most familiar form, as a simple judgment. Thus the reactor may be told: 'You will be shown words, names of objects, and you are not to react till you have thought of the most important part of each object.' Then, if the word 'chair'

is shown, he cannot associate to it the first part of a chair which comes to his mind, but must let his attention play upon the whole idea of chair, and select the most important part. He must pass a simple judgment. It is found that a reaction of this kind lasts about 150 σ longer than a 'free association' reaction.

The value of the association reaction, like that of the reaction experiment in general, is twofold. In the first place, it gives opportunity for the introspection of the associative consciousness. In the second place, it confirms, in an objective way, many of the facts with regard to association which introspection had revealed. Thus we learn that it takes longer to argue deductively than to argue inductively; it is less easy to illustrate a principle than to build up a theory from individual facts. Again, the times required for various free associations are indications of the reactor's intellectual temperament or constitution (§ 54); and so on.

It has been suggested that natural, untrained reactions, made without introspection in various sense-departments, would furnish indications of the dominant memory-types (§ 75) of the reacting subjects. The 'visual' thinker would react most quickly to a visual stimulus, the 'auditory' thinker to an auditory, etc. The suggestion deserves careful testing: the results obtained so far are ambiguous.

References for Further Reading

James, *Principles*, I, pp. 85–97, 427–434, 523–528, 557–561; II, pp. 131–133.

Külpe, *Outlines*, §§ 69–71.

Wundt, *Grundzüge*, II, xvi (§§ 1–3).

Consult also: S. Exner, in *Pflüger's Archiv*, 1873 ff.; A. Pilzecker, *Die Lehre von d. sinnlichen Aufmerksamkeit*, 1889; E. C. Sanford, in *Amer. Journ. of Psych.*, 1898 (describes the 'vernier chronoscope,' an inexpensive reaction-time apparatus, accurate to $\frac{1}{50}$ sec.). References to the monographic literature of the reaction experiment will be found in Wundt's *Grundzüge*; the names of J. McK. Cattell and L. Lange (*Phil. Studien*, 1885 ff.; 1888) should be mentioned.

CONCLUSION

CHAPTER XV

The Ultimate Nature of Mind. Mind and Body

§ 99. **The Mind of Psychology.** — We defined psychology, at the outset of our enquiry, as the science of mental processes. Mind, we said, is the sum total of mental processes experienced during a lifetime; or, if looked at from our own special point of view, the sum total of mental processes experienced between the limits of childhood and senility.

We have, however, more than once had occasion to notice the fact that in popular thought and language mind is something more than a sum of mental processes: that it is regarded as a permanent background, against which the processes stand out, or an active and directive principle, by which the processes are originated or regulated. We have ourselves refused as psychologists to accept the popular view, and have kept within the limits laid down by our definition. But now that our survey of mental processes is concluded, we may pause for a moment to ask whether our rejection is warranted, or whether there is not this one question that still remains to be examined, this one important psychological problem which we have ignored, and which nevertheless calls for explanation.

It is to be noted in the first place that, whether we have or have not faced all the questions that a psychologist is in duty bound to face, we have, so far as we have gone, justi-

fied the claim of psychology to be called a science. We have ascertained the nature and attributes of the simplest mental functions and processes, and of the bodily functions and processes to which they correspond; we have seen how the developed mind is built up from its elements; we have found that there are psychological laws, uniformities of mental occurrence, which have as their condition certain physiological laws, uniformities of occurrence within the living body, etc. In short, we have proved that mental phenomena can be arranged in as orderly and systematic fashion as the phenomena dealt with by physics or physiology. There is no fact of mind, as we have defined mind, which has resisted our methods of investigation; no process of which we have been compelled to say 'We cannot see any hope of accounting for this; it contradicts what we have previously said.' — It may perhaps be, then, that we have neglected a question which we should have raised. But, so far as we have asked questions, we have been able to offer consistent answers.

In the second place, however, there does remain the doubt whether our definition of mind is warranted; whether we should not take up the popular view of mind, and try to give reasons for it, — to reconcile it with our psychology, if reconciliation is possible; to show cause for persisting in our opinions, if reconciliation is impossible. Is there not a mind, behind mental processes? Is not mind active, spontaneous, self-moving, self-directive? Is not mind single, unitary, — continuous and not disjointed, coherent existence and not a mere aggregate of disconnected consciousnesses?

These are all important questions. If psychology can reply to them, and if our psychology has not replied to

them, then most certainly our procedure has been unwarranted, and our description of mind is one-sided and incomplete. But can psychology reply to them? Let us consider them in order.—In doing this we must remember always that, within the sphere of psychology, introspection is the final and only court of appeal, that psychological evidence cannot be other than introspective evidence. On this point all psychologists would be agreed.

(1) There is no psychological evidence of a mind which lies behind mental processes. Introspection reveals no trace of it: whenever we look inward, we find nothing but processes, of varying degrees of complexity. If we believe in the existence of a mind, distinct from mental processes, we do so for extra-psychological reasons. As Professor Ebbinghaus puts it: "Had it been, by any chance, of greater import and greater value for the emotional needs of the naïve man that there should *not* be than that there should be Minds, the arguments customarily adduced in favour of their existence would hardly have persuaded any one to exchange his negative and emotionally satisfying attitude for the positive one. The arguments are not only incapable of carrying conviction in their own right; they are essentially weaker than the arguments to the contrary."

(2) There is no psychological evidence of a mental 'activity,' above or behind the stream of conscious processes. 'Activity' and 'act,' vehicle of mental contents and contents itself, are not different and independent things. Professor Külpe says that the experience of "an urgency from within outwards, a mental strain, an activity of the self," reduces always to sensation and affection; and this we ourselves found to be the case (Ch. VI.).

(3) There is no psychological evidence of mental continuity and coherence which cannot be met by evidence of a contrary tenor. It is true that memory-ideas connect the present with the past; but it is equally true that one consciousness may be succeeded by another which is totally different from it. It is true that organic sensations, often pleasant or unpleasant, are constituents of all my consciousnesses; and that I am always called by the same name, always treated as the same self. Yet I know from those very persons who call me by one and the same name that I have 'forgotten' many incidents of my life; and I know that my selfhood lapses every night in sleep; — I know, that is, that there are great gaps in my mental experience.

So far, then, we find no reason to change our position. But an objection may still be raised. "Are you not considering mind," the critic may say, "from an exclusively structural, anatomical point of view? Might not these questions be answered affirmatively, if you regarded mind physiologically, as a system of functions?" This objection must be briefly met.

The root-function of mind is *willing*. The impulse, composed of (1) sensations, given in the state (2) of passive attention, and therefore (3) keenly felt, is thus the simplest functional process of consciousness. The will-function divides, as mental development proceeds, into the three part-functions of intellection, feeling and action (*cf.* p. 307). — If, then, substantiality and activity are to be demonstrated of mind in its functional aspect, they must be demonstrated of mind as Will.

The question has been argued, for and against, in the long-drawn-out controversies upon the *freedom of the will*.

We cannot here enter into any independent examination of this matter; we must be content to accept the verdict of competent psychologists. Now we find Professor James saying that "the question of free-will is insoluble on strictly psychologic grounds"; but that "psychology, as a science, can safely postulate determinism, even if free-will be true" in philosophy. And we find Professor Wundt, in the same way, referring the final settlement of the dispute between determinism and indeterminism to philosophy, but himself maintaining, as psychologist, the thesis that "voluntary and involuntary actions" differ not as causeless and caused, but "rather in the *character* of the causality" to which they are subject. We need not seek further. If we believe in the spontaneity of the mind, functionally regarded, we do so (as we did before) for extra-psychological reasons.

§ 100. **Mind and Body.** — We have laid it down as a rule without exception that every mental process has as its condition a bodily process, some change in the central nervous system and, more particularly, in the cerebral cortex. "No psychosis without neurosis:" there is no mental state which has not a peculiar nervous state corresponding to it. There are two current views as to the nature of this correspondence: the theories of *interaction* and of *parallelism*.

(1) The theory of the interaction of mind and body is that which is current in popular psychology, and which therefore seems most 'natural' to us before we examine it critically. It is also closely connected with the belief in the activity and spontaneity of mind (p. 306). Roughly formulated, it asserts that mind and body are independent things, each capable of influencing and of being influenced by the other. We cry because we are grieved; we run to

catch a train because we know we are late: mind influences body. On the other hand, we are unable to think clearly because we have eaten too hearty a dinner; we feel pain because we have torn the skin of our finger: body influences mind.

The principal argument in favour of this theory is the argument which emphasises the absurdity of any other view. What is mind for, it asks, if it is not to influence and to be influenced by the body? In more scientific terms: how could mind have been developed, how could 'natural selection' have laid hold of it, if it were not of some practical benefit to the organism? and how can it be of practical benefit except by way of interaction with the body? The human mind is too complicated and elaborate a thing to be wholly useless; and it is only by interaction that it can become useful. — To which we may reply: it need not be the mind which is useful to the organism, but the brain upon which mind is conditioned. I may run to catch the train, not because I know I am late, but because my brain is the scene of an excitatory process underlying this idea of lateness. A man may succeed in life not because he has a superior mind, but because he has a superior brain, *i.e.*, a superior substrate of mind. Mind itself may be simply the efflorescence of brain-activity, an invariable concomitant and valid index of brain-value, but itself only an 'epiphenomenon,' a symptom and not a cause.

Argument and counter-argument are neither of them decisive. There is, however, a strong positive objection to interaction, an objection which takes two forms according to circumstances. (*a*) The theory that the mind influences the body spontaneously, of its own initiative, contradicts the law of the conservation of energy. This law lays it down

that in all the changes and chances of the material universe one factor remains constant,—the factor of energy, or power to perform mechanical work. Now the living organism is a part of the material universe. The sum total of the organism's output (heat, movement, etc.), then, must show an energy precisely equal to the same organism's total intake (food, etc.). But if the mind can cause bodily movements, the organism puts out *more* than it has taken in. (*b*) We might escape this difficulty by supposing that the mind is itself a form of energy; so that mental energy interacts with physical. We thus give up the spontaneous activity of mind, and reduce mental influences to law. But at the same time we raise a further difficulty. The universe of natural science is a *mechanical* universe; all forms of energy in the various sciences are reducible to mechanical energy. The introduction of a new form of energy, mental energy, interferes with this conception. It is a waste of time and thought to reduce all the energies of the universe *but one* to mechanical energy; the exception simply upsets the rule. And to say, *e.g.*, that a movement which means heat-energy outside the organism ceases, within the organism, and is transformed into the mental energy of the sensation of grey, is to use a form of words to which no real meaning can attach.

We find here, then, as we have found elsewhere, that the popular and the scientific ways of looking at a problem are by no means accordant. Let us now try the alternative theory.

(2) We may begin with an illustration from the old fairy-tales. Think of a princess, confined within a magic circle, and of an adventurous prince who attempts her deliverance. Prisoner and rescuer are separated by the

enchanted barrier, — separated, of course, by one and the same barrier. But the princess can see only the inside, the concavity, of the circle; the prince can see nothing but its outside, its convexity. The magician, looking down from above, sees the whole circle, concave-convex and convex-concave. Now the theory of *psychophysical parallelism* declares that the relation of mind to body is the relation of concave to convex in the circle. If we are working in psychology, our world is concave; any change in the world is simply a change of concavity. If we are working in natural science, our world is convex; any change in it is simply a change of convexity. Really, however, every change on the one side runs parallel to a corresponding change on the other: concavity cannot alter without alteration of convexity, and *vice versa*. Only, the investigator must be either princess or prince; he cannot be magician.

Or again: suppose that we are envisaging the solar system from the earth as centre. The universe is the Ptolemaic universe. Suppose that we envisage it from the sun as centre: it becomes the Copernican universe. To the observer who stands altogether outside of the system, there is no contradiction between the two universes: the system is both Copernican and Ptolemaic. To an observer within the system, it must be either the one or the other; no one can take his imaginary stand, at one and the same moment, both upon the earth and upon the sun. Now the theory of parallelism declares that the relation of mind to body is the relation of Ptolemaic to Copernican construction of the solar system. We work either on the earth or on the sun; if we could transcend our human powers, and work from a point of vantage which should show both

beneath us, the two constructions would prove to be but two aspects of the one real interpretation.

Acceptance of this principle of parallelism, as a working hypothesis in psychology, enables us to avoid all the conflicts and difficulties into which the principle of interaction plunges us. Natural science asserts that its universe is a mechanical universe; that the law of the conservation of energy holds without exception, for the living organism as for the stone; that the chain of cause and effect is a closed chain, never interrupted. We have now no reason or wish to challenge any one of these statements. Psychology and natural science will be helpful to each other, mutually regulative, — change in convexity indicating change in concavity, and *vice versa;* disagreement or interference is impossible.

§ 101. **The Mind of Metaphysics.** — We might consider that our task is now completed. We have our science in outline before us; the problems that arise out of it must be passed on to the discipline that undertakes the complete synthesis of scientific results, to metaphysics. Nevertheless, we have raised philosophical questions, here and there, in the course of our discussion; and it is not satisfactory to ask, and to receive no sort of answer. We will conclude, then, with a glance at the chief metaphysical views of the nature of mind.

(1) We have seen that the first sciences to arise are the sciences of nature; the method of analysis finds its first field of application in the outward and external (§ 1 *a*). It is natural, then, that the first metaphysics should be *materialism*, that mental should be explained as merely a kind of corporeal existence. To the naïve reflection of primitive philosophical thought the mind is air, or

fire, or ether, — matter the most attenuated that can be found.

Modern philosophy has outgrown these conceptions. But materialism, as a metaphysical position, has persisted down to the present century. It doubtless furnishes to a certain type of mind an explanation of the universe which follows the 'line of least resistance' in speculative construction; but it has also, without any doubt, been kept alive, as it were, artificially, by its polemical usefulness, its anti-theological and anti-spiritualistic implications. In its modern form, it maintains that mental processes are the resultant of the finest and most delicate motions of the brain-molecules, or secretions from the brain's general activity. Thus the French physicist and philosopher, P. J. G. Cabanis (1757–1808), writes that "to form a just idea of the operations from which thought results, we must consider the brain as a particular organ intended for its special production; just as the stomach and intestines effect digestion, the liver filters the bile, and the parotids and maxillary and sublingual glands prepare the salivary fluids." — It may be said, without qualification, that materialism is no longer current as a metaphysical theory.

(2) Over against materialism stands *spiritualism*. Spiritualism, which took shape comparatively late in the history of thought, is the direct antithesis of materialism. For it, the real things of the universe are independent, simple, substantial minds. Matter has only an apparent and specious reality; it is, in essence, nothing more than a complex of ideas.

It is clear that spiritualism is as one-sided, and as speculatively one-sided, as is materialism. It has, however, two emotional advantages over its rival. In the first place, it is

a theory of aspiration, a theory that seems to ennoble the world by raising it to a plane higher than that of brute matter. Secondly, it is an anthropocentric theory. Materialism places the reality of things outside of and apart from man; spiritualism declares that the essential part of man, his mind, is of a piece with the reality of the universe. The scheme of the world is ennobled, then, and ennobled by being humanised. Both aspects of spiritualism have told strongly in its favour. When we add to this the further fact that spiritualism is capable of a much more logical and comprehensive formulation than is materialism, we shall not be surprised to find that, though not held perhaps in the precise form in which it has been phrased above, spiritualism (as 'idealism' in some one of its many dresses) is to-day the reigning metaphysics.

(3) We may accept all the results of scientific psychology, and adopt the principle of parallelism as an empirical rule of work, — and still be either materialists or spiritualists in our philosophical creed. At the same time, neither the materialistic nor the spiritualistic hypothesis receives any direct support, whether from psychology at large or from the parallelistic interpretation of psychology. The metaphysics to which science points us is rather a metaphysics in which both matter and spirit disappear, to make way for the unitary conception of *experience*.

The given fact from which a theory of the universe must set out — so this line of reasoning runs — is the concrete, individual, human experience. This experience is at first neither spiritual nor material, neither subjective nor objective, neither experience of the self nor experience of the outer world, the not-self. It is single and undifferentiated. By slow degrees, however, it divides into

halves: subject and object stand over against each other, as separate things, the object taking shape much more quickly and definitely than the subject (*cf.* § 1 *a*). When the division has been completed, and mankind has reached a sufficiently high stage of development, each half is taken as the basis of a group of special sciences. The objective half is abstracted from the whole and worked up in the natural or physical sciences: the subjective half is abstracted from the whole and worked up in the mental sciences. The former treat of experience, by abstraction, as independent of the experiencer: the latter treat of it, by a similar abstraction, solely in its dependence upon the experiencing individual.

This is the situation which confronts the two philosophical disciplines, epistemology and metaphysics. It is the problem of epistemology or 'theory of knowledge' to explain how the concrete experience, originally one, has come to be divided up under an objective and a subjective aspect; what there is, in the nature of truth, to make this division necessary and helpful; and what measure of truth attaches to each side of the division at the present stage of the world's thought. It is the problem of metaphysics, which unifies and harmonises the principles and laws of all the sciences, to take the conclusions reached by way of the two abstractions from experience just mentioned, the conclusions of both the natural and the mental sciences, and in their light to explain the given fact from which they are derived, the concrete experience itself.

The psychologist cannot long hesitate between the choices offered to him. The philosophy of experience points him to his place alongside of the physicist and the chemist; justifies his working principle as an adumbration

of the real relation of 'mental' to 'bodily'; and brings down philosophy itself from the clouds of speculation, to serve as guide and director of scientific progress. As man of science, he is dealing with an organism, — with an organised structure, with a system of functions, with a developing whole; he has no concern with ultimates. As philosopher, reflecting upon the data and methods and results of science and scientific enquiry, he finds a resting-place for thought in Experience, — than which, as Shadworth Hodgson says, there is no larger word, and but for which we have in the last resort no means or materials for framing any hypothesis whatsoever.

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